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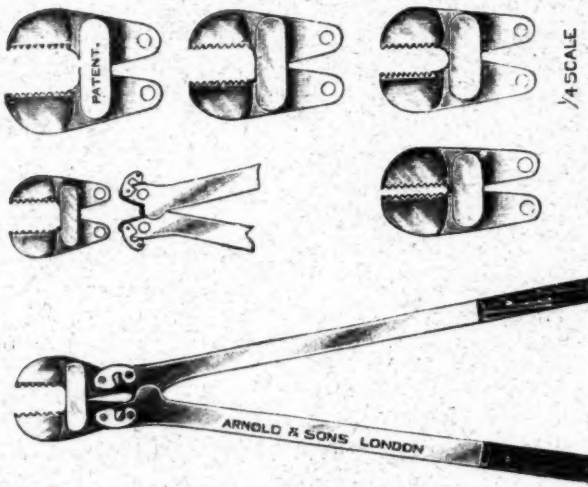


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# CONTENTS.

PAGE

EDITORIAL—

Vaccination for Anthrax ... ... ... ... ... ... ... ... 513

GENERAL ARTICLES—

Topography of the Abdominal Viscera of the Dog. By O. CHARNOCK BRADLEY, M.D., D.Sc., M.R.C.V.S. ... ... ... ... ... ... ... 515

Some Common Forms of the Equine Perfoliate Tapeworm (*Anoplocephala Perfoliata* Goeze). By A. W. NOEL PILLERS, F.R.C.V.S., F.Z.S. ... 521

Anthrax, with Special Reference to the Production of Immunity. By C. F. DAWSON, M.D., D.V.S. ... ... ... ... ... ... ... ... 524

Pyæmic Hepatitis Affecting Sheep. By J. A. GILRUTH, D.V.Sc., M.R.C.V.S., F.R.S.E. ... ... ... ... ... ... ... ... ... ... 541

University of London. Preliminary Examination in Veterinary Science for Internal and External Students ... ... ... ... ... ... ... ... 545

CLINICAL ARTICLES—

The Diagnosis of African Coast Fever. Gland Puncture. By L. E. W. BEVAN, M.R.C.V.S. ... ... ... ... ... ... ... ... 546

Equine Melano-Psammomata of the Encephalon. By W. M. SCOTT, F.R.C.V.S. ... ... ... ... ... ... ... ... ... ... 547

Keratoma, Resulting from a Picked-up Nail. By Captain A. J. WILLIAMS, F.R.C.V.S., A.V.C. ... ... ... ... ... ... ... ... 549

Note on the Presence of Sclerostoma Equinum in the Liver. By Captain A. J. WILLIAMS, F.R.C.V.S., A.V.C. ... ... ... ... ... ... 551

Fracture of the Fifth and Sixth Lumbar Vertebræ. By Captain A. J. WILLIAMS, F.R.C.V.S., A.V.C. ... ... ... ... ... ... 551

Eversion of the Bladder in a Mare. By FREDERICK HOBDAY, F.R.C.V.S. ... 553

Spasm of the Diaphragm in a Cow. By H. K. KREDO ... ... ... ... 554

Cerebro-Spinal Meningitis. By HENRY B. EVE, M.R.C.V.S.... ... ... 555

(*Continued on p. xi.*)

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## CONTENTS—*continued.*

PAGE

ABSTRACTS AND REPORTS—

Brief Report on the Veterinary Institutions of Japan. By R. F. KNIGHT and C. G. THOMSON ... ... ... ... ... ... ... ... ... 556

Feeding and Immunity in Hæmorrhagic Septicæmia and Rinderpest. By Major F. S. H. BALDREY, F.R.C.V.S., D.V.H., I.C.V.D. ... ... 562

The Feeding of Equines. By J. M. CHRISTY ... ... ... ... ... 570

TRANSLATIONS—

Transmission of Infectious Diseases to Animals in the Exercise of Veterinary Medicine. By Major M. P. REMLINGER ... ... ... ... ... 572

Alopecia Areata. By Staff Veterinary Surgeon POHL .. ... ... ... 574

Poisoning with Red Lead. By Staff Veterinary Surgeon KLINGBERG... ... 575

A Case of Stranglous Encephalitis. By BOUET .. ... ... ... ... 576

LETTERS AND COMMUNICATIONS, &c. ... ... ... ... ... 576

BOOKS AND PERIODICALS, &c., RECEIVED ... ... ... ... 576

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# VETERINARY JOURNAL

SEPTEMBER, 1911.

## Editorial.

### VACCINATION FOR ANTHRAX.

THE subject of protective inoculation against anthrax bids fair to become of much greater importance to the practitioners and agriculturists of Great Britain than heretofore. It is an undeniable and unfortunate fact that outbreaks of anthrax in this country are increasing with considerable rapidity, and therefore any work on this question deserves to be closely followed so that any practical results can be adopted where applicable. It is with that end in view that we publish the article on this important subject in this issue of the VETERINARY JOURNAL, by Dr. Dawson, taken from a bulletin of the Bureau of Animal Industry. Space prevents us reproducing the whole of the bulletin, so we have taken up that portion referring to the production of immunity.

After going into detail concerning the Pasteurian method of immunizing against anthrax and satisfying himself as to the efficacy of that method, Dr. Dawson refers to the inconvenience entailed by two inoculations with the necessary interval, and the possible disastrous effects resulting from inoculating the second vaccine by mistake for the first. He reasonably concludes that it would be much better if a safe, reliable and effective single vaccine could be produced. Dr. Dawson claims to have accom-

plished this, and by his method the period required for the production of immunity is reduced by one-half, a matter of great importance in attempting to control any serious outbreak.

This method of vaccination, and also the double vaccine method, can be combined with the use of antianthrax serum, which, if used alone, produces an immediate passive immunity of only a very short duration, but just about long enough to enable the vaccine to produce the more durable active immunity.

That there are possible dangers such as are inseparable from any vaccination where pathogenic organisms are used must not be overlooked. If used indiscriminately new centres of infection might be established. Dr. Dawson has shown that anthrax bacilli may persist for at least eighteen days in the body of an immune animal. But what has not been shown, so far as we are aware, is the length of time bacilli may be present in an animal as the result of vaccination. Active immunity as the result of vaccination is undoubtedly due to recovery from a mild attack of the disease. During that mild attack it is conceivable that the vaccinated animal may be discharging infective material. That is a matter that requires solution. Another question that arises out of that is whether this mild attack may or may not be converted into a virulent attack by some such adverse complication as a reduced vitality of the patient or the development of a febrile condition from some other cause.

Until these points are elucidated therefore, it is doubtful whether anthrax vaccination can be definitely recommended in the present state of the disease in Great Britain. It is a different question, however, in those countries where the outbreaks are more severe and where considerable numbers of animals perish at each outbreak. In such cases there appears to be little doubt that the best method of procedure is to apply the combined method of inoculation of serum and vaccine as soon as the outbreak is discovered.

In this country, however, where the mortality at each outbreak of anthrax is very low, the use of antianthrax serum alone, as soon as anthrax has been diagnosed, would be sound economy. It would most probably ensure the safety of the remaining animals that had been infected by the fatal case or from the same original source, but in which the bacilli had not yet invaded the blood stream.

# General Articles.

## TOPOGRAPHY OF THE ABDOMINAL VISCERA OF THE DOG.

By O. CHARNOCK BRADLEY, M.D., D.Sc., M.R.C.V.S.

*Principal of the Royal (Dick) Veterinary College, Edinburgh.*

Doubtless the operator, as the result of experience alone, in time becomes familiar with the position of organs though he may have had no assistance from a printed guide. In the case of the abdominal organs, valuable though ordinary dissection of the dead body may be, it is impossible to obtain an accurate knowledge of topography without extensive examination of specially prepared material. The mere opening of the abdomen and the inspection of its contents during an ordinary *post-mortem* examination is liable to lead to misconception of the position of the organs. This is more particularly the case if the thoracic cavity is opened as well. So long as the organs are flaccid, the removal of the support afforded by the abdominal wall results in displacement—sometimes more, sometimes less. If in addition the thorax is opened the resultant movement of the diaphragm exaggerates the displacement of the abdominal viscera. In order to obtain an accurate conception of abdominal topography it is, therefore, imperative that the viscera be fixed and hardened thoroughly before their inspection is undertaken. It is further necessary that the examination be conducted with care and accuracy.

So far as the topography of the abdominal viscera of the dog is concerned, the surgeon is practically limited for guidance to certain figures given by Ellenberger and Baum* and Sisson.† In these works, with the exception of two photographs reproduced in Sisson's recently published book, views of the organs are given from the side. Seeing that the bulk of operations are conducted with the animal lying on its back, these figures are in consequence of general value only.

In order to supply what was felt to be a want, a series of new observations has been made. A number of bodies of dogs of different breeds and of both sexes were thoroughly hardened

* Ellenberger und Baum. "Anatomie des Hundes," Berlin, 1891.

† Sisson. "A Text-book of Veterinary Anatomy," Philadelphia and London, 1910.

by the injection of a strong formol solution into the arteries while the animals were lying on the back. The wall of the abdomen and the organs in the cavity were then carefully dissected step by step and outline drawings made at different stages. In order that the exact relative positions might be recorded without possibility of error, the sketches were made through a wire screen. In the construction of the screen itself no precaution was omitted to ensure that it should contain perfect squares measuring 20 mm. each way. The outline drawings were made on paper ruled in squares corresponding in size with those of the screen, and all care was taken to make sure that the different dissections were viewed from a point immediately over the centre of the abdomen. The screen was adjusted each time so that one of the wires lay over the middle line of the body, and a cross wire lay immediately over the margin of the pubic bones at the symphysis. This method of investigation is not by any means new as it has been extensively used in human topographical anatomy.

The average positions of the various organs as determined in this way is indicated in the accompanying diagrams. Though these fail of their object if they are not self-explanatory, it may be well to draw attention to certain points and comment upon some of the variations which have been encountered. Fig. 1 is introduced to show the average extent of the fleshy part of the four abdominal muscles. In order to secure as much clearness as possible the external oblique (M.o.e.a.) and straight (M.r.a.) muscles are shown on the left side of the diagram, and the internal oblique (M.o.i.a.) and transverse (M.t.a.) muscles on the right side. On both sides the margins of the muscles are shown in dotted lines in order to indicate the extent to which one muscle overlaps another. The tendinous portions of the muscles are omitted.

It is interesting to notice that a narrow strip of the abdominal wall along the lateral margin of the straight muscle contains only the transverse muscle, whereas lateral to this there are two or three muscles depending upon the distance from the middle line. The external oblique does not at any point overlap the straight muscle, and the internal oblique does so only in the neighbourhood of the inguinal canal. In short, the superficial sheath of the straight muscle is entirely aponeurotic, while

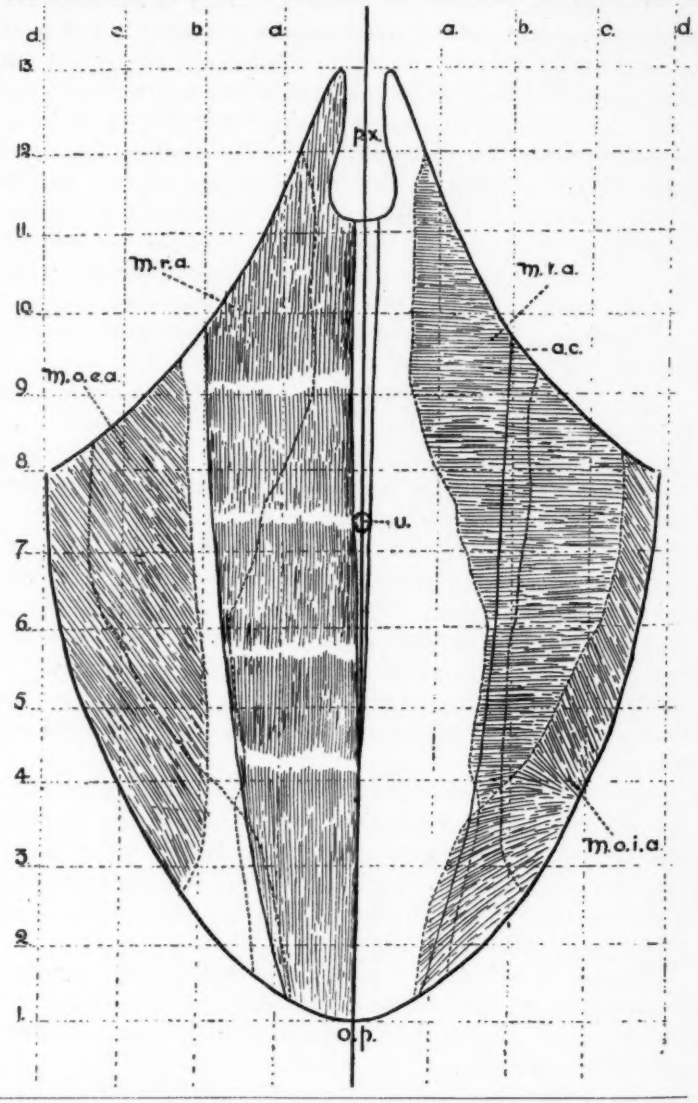


FIG. 1.

*M.o.e.a.*, external oblique muscle; *M.r.a.*, straight muscle; *M.t.a.*, transverse muscle; *M.o.i.a.*, internal oblique muscle; *a.c.*, costal arch; *o.p.*, pubic bones; *p.x.*, xiphoid process of the sternum; *u.*, umbilicus.

its deep sheath is only partly muscular cranial to the umbilicus where the straight and transverse muscles overlap. It may be of moment to note that the straight muscle has one of its tendinous inscriptions on a level with the umbilicus and two caudal to this point. From its relationship to the underlying viscera, it should be added that in a thin animal it is not altogether difficult to determine the position of the lateral margin of the straight muscle during life. The last feature of the wall of the abdomen to which attention will be directed is the distance between the two straight muscles. In the region of the pubic bones the two muscles are close together; that is, the linea alba is exceedingly narrow. Towards the sternum a considerable interval separates the medial borders of the muscles.

The solid organ in which variability of position has the greatest range is the liver. Occasionally scarcely any of it appears beyond the costal arch. In other specimens it may reach to within a short distance of the umbilicus, and this without there being any pathological enlargement appreciable to the naked eye. The position as shown in the diagram (Fig. 2 h.) represents the average and may be taken as indicating the condition during inspiration. Naturally the position of the fundus of the gall-bladder fluctuates with that of the liver; but it may be said that in the majority of cases, when the abdominal wall has been removed, it is to be found in the space circumscribed by the xiphoid process of the sternum and the right costal arch (Fig. 2 v.f.).

Naturally the precise extent of the stomach depends upon the amount of ingesta contained therein. This being so inconstant it was not considered profitable to include the outline of the whole viscus in the diagram. The pylorus, however, being a comparatively fixed part is indicated as lying in the vicinity of the gall-bladder (Fig. 2 p.).

Because of its change of position dependent upon the amount of distention of the stomach, it is doubtful if anything very definite can be said of the topography of the spleen. Its dorsal extremity is certainly capable of precise location, since it is in contact with the left kidney (Fig. 2 l.); but the ventral part of the organ was found to be exceedingly variable. Sometimes it merely peeps out from underneath the costal arch; on the other hand it may extend for some distance towards the middle

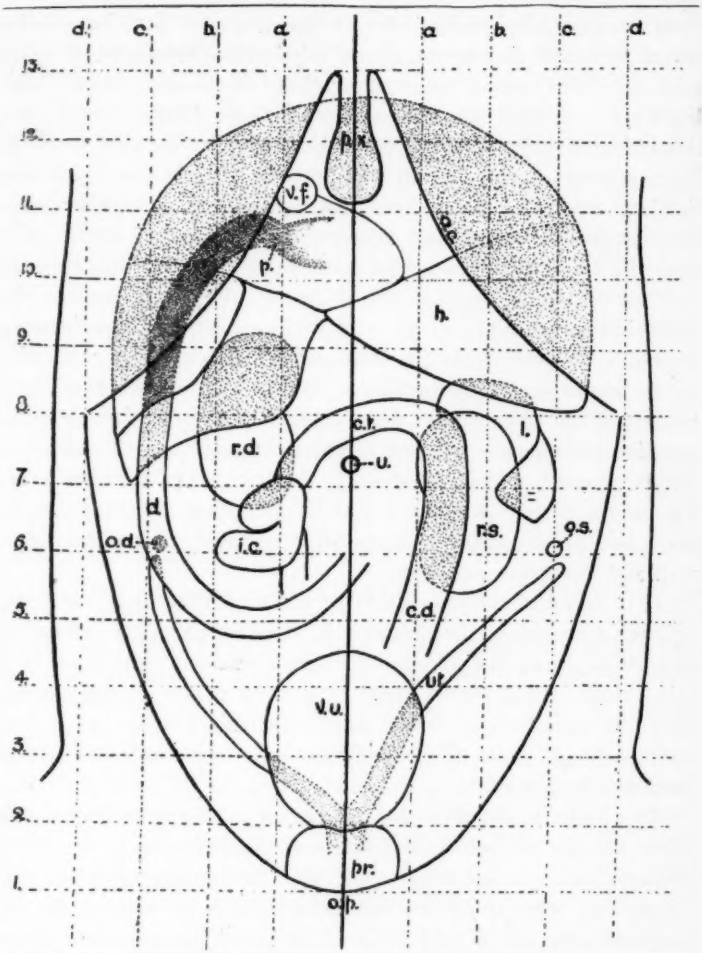


FIG. 2.

*v.f.*, gall-bladder; *p.*, pylorus; *h.*, liver; *r.d.*, right kidney; *c.t.*, transverse colon; *l.*, spleen; *d.*, duodenum; *i.c.*, cæcum; *r.s.*, left kidney; *c.d.*, descending colon; *o.d.*, right ovary; *o.s.*, left ovary; *v.u.*, urinary bladder; *ut.*, uterus; *pr.*, prostate; *a.c.*, costal arch; *o.p.*, pubic bones; *p.x.*, xiphoid process of the sternum; *u.*, umbilicus.

line of the body. The position of the kidneys, on the contrary, may be indicated with considerable precision. Supposing the distance from the pubic bones to the angle of junction of the costal arch and the sternum be divided into thirteen equal parts as is done in the diagram, the middle of the length of the right kidney is at about 8/13ths of this distance (Fig. 2 r.d.); the left kidney being at nearly 7/13ths of the distance (Fig. 2 r.s.). Each kidney is roughly half-way between the median plane and the lateral wall of the abdomen; or, putting it in another way, the convex border of the kidney is approximately on a level with the lateral margin of the straight muscle of the abdomen.

The cæcum (Fig. 2 i.c.) is related to the caudal end of the right kidney and at no great distance from the middle line. Probably no part of the intestinal tube shows greater variability in its length and conformation. In the bulk of the specimens examined the cæcum was short and so bent as to form a comparatively compact mass; but in some cases the length was much greater, and in two instances (both young St. Bernards, 7½ months♂, 8 months♀) it was so long and capacious as to form one of the objects visible after removal of the abdominal wall and the great omentum.

It is doubtful if the position of the ascending and transverse colons as shown in the diagram is of much practical value; for though it shows the average for the specimens examined, it is an average about which there is a wide range of fluctuation. In some specimens it could hardly be said that an ascending colon existed, while in others it was of considerable length and even disposed in coils.

It was expected that the ovaries would be found as a rule fairly closely related to the kidneys. Such certainly was their position in some specimens, but that the average position was some little distance from the kidney is demonstrated by the diagram (Fig. 2 o.d. and o.s.). The broad ligament permits of considerable excursions of the uterus; consequently the diagram affords merely an approximation of its position.

The last point which needs mention relates to the prostate (Fig. 2 pr.). In every specimen examined practically the whole of this structure showed beyond the edge of the pubic bones. A very small portion of it might occasionally be described as having a real pelvic situation.

In the course of this short investigation, wherever an organ showed signs of pathological change it was rejected; and, if any viscus was so enlarged, distorted or shrunken as to make it possible that an effect might have been produced in the position of other viscera, the whole abdomen was put aside.

Possible objection may be raised that no distinction has been made between the male and the female abdomen. (The diagram is obviously hermaphrodite.) When the work was entered upon it was intended to compile two outlines—one for the male and one for the female. As the work proceeded, however, it became evident that this was unnecessary, since sex has apparently little or no influence upon the position of the majority of the organs. Beyond question the presence of a gravid uterus cannot fail to produce a disturbing influence of some degree; and, had it been possible to obtain a sufficient number of pregnant females, the result of pregnancy would have been shown in diagrammatic form. Paucity of suitable material, however, has prevented the inclusion of such a diagram in the present short communication. If time and material are available, it is intended to continue the observations in this direction.

---

## SOME COMMON FORMS OF THE EQUINE PERFOLIATE TAPEWORM (*ANOPLOCEPHALA PERFOLIATA* GOEZE).

By A. W. NOEL PILLERS, F.R.C.V.S., F.Z.S.
*Sheffield.*

During the last two or three years, whilst examining the bowel contents of dead horses in this district, I have often come across animals infested with the above worm, and they appear to vary in their external characters to such a degree that one veterinary surgeon spoke of the different forms as representing different worms. *A. perfoliata* is distinguished from the other horse tapeworms by the presence of four rounded lobes which appear to arise from the hinder aspect of the head, two being on the ventral and two on the dorsal surface of the neck. There has, however, been some confusion with regard to the smaller forms of this species and *A. mamillana* Mehlis. Cobbold seemed to doubt the very existence of this latter species, and I have seen specimens labelled *A. mamillana* which turned

out to be small forms of *A. perfoliata* on careful examination. That such different forms exist is further shown by the fact that many helminthologists have thought it necessary to give these different forms specific names. When the equine perfoliate tapeworm was regarded as belonging to genus *Tænia*, Baillet described a *T. innome* and Megnin mentioned a *T. inerme*. Both of these were regarded by Cobbold as subspecies or varieties of *T. perfoliata*. Thus he spoke of them as *T. perfoliata* var. *Bailletii* and *T. perfoliata* var. *Megnini* respectively. The following remarks and sketches refer to some of the common forms met with. The chief variations are those of size, shape, colour and configuration of the head and neck.

The first form that should be mentioned is a small worm about 20 mm. long and 5 mm. broad. The head is small and set on the neck. The four cephalic lobes are only just visible,

FIG. 1.

FIG. 2.

when carefully examined, at the junction of the head and neck. This form is often mistaken for *A. mamillana*. Although I have seen it in collections it does not appear to be common in this district.

A second type is represented in Fig. 1. The worm from which this sketch was made was taken with others from the cæcum of a horse destroyed on account of stifle lameness. He had been at grass for some months. The length of the worm was 34 mm., and its greatest width at the anterior third of the strobile was 12 mm. At the junction of the anterior and middle thirds the segments gradually became narrower until the posterior extremity ended in a point. The four cephalic lobes projected from the junction of the head and neck, but it was not possible to say to which they belonged. Another peculiar point was the "let in" and asymmetrical position of the head. The colour was yellowish with a tinge of green.

Fig. 2 was made from a specimen which, with many others of similar characters, was found in the same infestation as the above worm. The colour was the same. The head, however, was much more prominent, but still let in and inclined to one side. The length of the worm shown was 27 mm. with a width of 13 mm. at the widest point. The terminal segments were about 11 mm. wide. Probably the terminal sterile segments as seen in Fig. 1 had been shed.

From an aged mare grazing in Derbyshire I obtained a great number of specimens, all of which resembled Fig. 3. The colour of this form was distinctly white without the slightest trace of green or yellow. The average length was about 40 mm. and the width 12 mm. It will be seen that the cephalic extremity is quite distinct from the preceding forms, inasmuch as it is quite symmetrical in position and not let into the vegetative portion

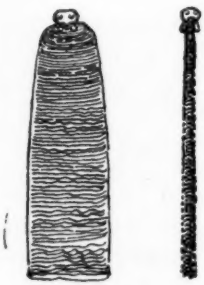

FIG. 3.

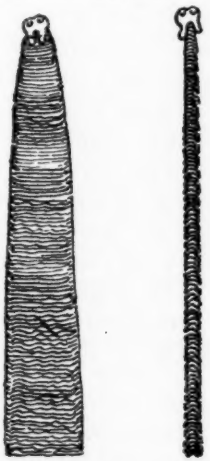

FIG. 4.

of the strobile. The widest portion of the worm was soon reached and remained about the same throughout the remainder of the segments. The cephalic lobes were rounded and well developed, and appeared to be separated from the head by a membrane, which was present on the dorsal and ventral surfaces, but not on the lateral aspects.

The last form appears to be found in imported pit ponies. Fig. 4 represents this type of tapeworm. The animal from

which it was taken was corn fed, and died of pneumonia whilst still in the mine. The colour of the worms was yellowish with a tinge of green. Their two most marked peculiarities, however, were their great lengths (50—70 mm.) and the marked development of the head. This was as wide as the neck and had become cube-shaped, with sides of about 3 mm. long. The cephalic lobes, instead of being represented by rounded masses, were seen to be backward projections from the hinder corners of the cube-shaped head. In some specimens these lobes attained a length of 2 mm. on one surface, whilst those of the other surface were always much shorter. The edges of the strobile as a whole appeared straight and slightly converging towards the head. I have heard this form spoken of as "the true horse tapeworm" by veterinary surgeons and knackermen.

It is not easy to offer an explanation to all of the above variations; and, moreover, it is not certain that they are of any great importance. However, having noticed them, I have recorded them for what the observations may be worth. Possibly Figs. 1, 2 and 4 are stages of growth, but Fig. 4 seems to stand out quite distinctly in regard to colour, shape and position of head, and its bilaterial symmetry. When compared with other tapeworms the specific differentiation of *A. perfoliata* from other members of the genus by means of the cephalic lobes seems very strong. One might even suggest that it were strong enough to be a generic value although it is an external character.

(The figures illustrating this article are drawn to natural size.)

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## ANTHRAX, WITH SPECIAL REFERENCE TO THE PRODUCTION OF IMMUNITY.*

By C. F. DAWSON, M.D., D.V.S.

*Introduction.*—Anthrax is primarily a disease of herbivorous animals, and occurs as an epizootic in sheep, cattle, horses, and mules, the animals being susceptible in the order named. In experimental work the small animals, such as mice, guinea pigs, and rabbits, are extremely susceptible. The French name for the disease is "charbon"; the German, "Milzbrand." When it occurs in domestic animals it is also sometimes known as splenic

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* From Bulletin 137, Bureau of Animal Industry.

fever. In natural outbreaks anthrax usually has the character of a rapidly fatal septicæmia, with the presence of large numbers of the characteristic bacilli in the blood.

While the disease does not occur as a natural infection in man in the same sense as in animals, man frequently becomes infected from handling infected animals or their products, such as hides and hair. When man becomes infected through abrasions of the skin, the resulting disease process is carbunculous in nature and is known as "malignant pustule." When the infection takes place in the lungs, the disease is known under the name "woolsorters' disease." A third form in man may attack the intestinal tract. The latter two forms are rapidly fatal. In malignant pustule the disease may remain localized and the patient may recover. If, however, the bacilli migrate from the local lesion to the blood stream, death rapidly ensues, the patient dying from septicæmia or toxæmia.

*Historical.*—Anthrax is one of the oldest diseases. Moses records it in Exodus ix. 9. Homer, Ovid, Plutarch, Virgil, Pliny, and many others have mentioned it in their writings. It exists in all countries and in all latitudes. It was formerly very destructive to human life as well as to animals. In 1617, near Naples, 60,000 people are reported to have died from anthrax. In San Domingo, in 1770, 15,000 persons perished in the short period of six weeks. This enormous death-rate was probably due, in part, to eating the carcasses of animals dead from the disease.

It was not until the middle of the nineteenth century that scientists began the serious study of this very destructive disease. In 1849, Pollender, while studying the blood of animals dead from anthrax, discovered numerous rod-shaped, microscopic bodies, which he claimed were the cause of the disease. This claim remained unsubstantiated until 1863, when Davaine announced that the bodies discovered by Pollender were bacteria, and showed that the blood of an animal could not cause anthrax in another animal when injected into it unless it contained these bodies. To this bacterium Davaine gave the present name, *Bacillus anthracis*. Davaine's views were not immediately accepted, but others took up the work, and in 1876 Dr. Robert Koch, in making his first contribution to bacteriology, announced that he had been successful in proving the correctness of

Davaine's work on anthrax, and the question was then accepted as settled. Koch isolated the bacilli in pure culture and demonstrated their ability to form spores. He claimed that natural infection takes place through the intestinal tract, although he was at first unable to demonstrate this by feeding food infected by artificial cultures. Later, Pasteur succeeded in producing anthrax by feeding hay sprayed with cultures of *Bacillus anthracis* when he at the same time mixed with the hay thistles or any plants that would cause pricking or abrasions of the intestinal tract so that the bacilli could pass into the tissues.

### Methods of Producing Immunity in Animals.

*The Existing Method of Double Vaccination (Pasteur Method).*

Since 1892 anthrax has been controlled by vaccination by a method devised by Louis Pasteur. This method consists in the subcutaneous injection of attenuated cultures of the bacillus of anthrax. Two injections of varying degrees of strength are made at an interval of 12 to 14 days. The first injection consists of 1 cubic centimetre of a culture that has been incubated at 42° to 43° C. for a sufficient time to decrease its virulence to a point where it will kill white mice, but not guinea pigs or rabbits. This generally requires a period of 24 days, assuming that the culture was made originally from a moist, virulent race of anthrax bacilli. Such cultures are to be made directly from the heart's blood of an animal that has died of anthrax within 48 hours after inoculation. In such blood we find only non-spore-bearing bacilli, and when these are grown at 42° to 43° C. they do not at any time produce spores while this temperature is maintained. Contrary to the statements of some, however, the bacilli promptly form spores when this temperature is reduced. These spores do not acquire any more virulence, however, than the parent bacilli which produced them.

The second injection consists of a culture similarly made and incubated at 42° to 43° C. for a period of 12 to 18 days, or one whose virulence has been reduced to a point where it will not kill rabbits but will kill white mice and guinea pigs, the latter in 3 or 4 days. The author's experience has shown that there is no hard and fast line in the number of days that a culture of a given race of anthrax bacilli must be attenuated. Much depends upon the resistance of the bacillus, the character of the culture

medium, the exactness of the temperature of the incubator, and the natural resistance of the animals used in testing the vaccines. When a culture of proper strength has been obtained and is properly transferred to fresh media about once a month and kept in a cool place where it will not evaporate, it may be used indefinitely as a stock culture for inoculating a liquid medium, which constitutes the vaccine. When such attenuated cultures are inoculated into animals, a very mild and clinically unnoticeable attack of anthrax is produced, which confers an active immunity which persists throughout the anthrax season. The inoculation must be repeated the following season.

Certain precautions are necessary in the application of anthrax vaccine. Assuming that the vaccine has been properly prepared, it is the duty of the veterinarian to ascertain that anthrax is not already existing in the animals he is about to vaccinate. As a precaution, when there is reason to suspect that anthrax may already be existing, no animal showing a fever should be vaccinated, as the disease may be carried from the already infected animal to others upon the point of the inoculating needle. Again, in order to prevent abscess in horses and mules by introducing under the skin streptococci or staphylococci by the point of the needle, the place of injection should be disinfected of these microbes. The anthrax bacillus cannot produce pus, but the germs usually found upon the skin are to be held responsible when abscess occurs from vaccination. The writer has been in the habit of dipping the point of the needle into strong carbolic acid contained in a small vial which may be conveniently carried in the side pocket at the time of vaccinating. None of this acid can enter the needle and kill the vaccine germs, as it is already filled with the vaccine, and none can be introduced under the skin, as it is all removed from the needle in its passage through the skin, and this in turn disinfects the wound made. While every veterinarian knows that hypodermic injections of medicine are daily made with a minimum of abscess production, it must be recognized that the conditions are not similar, and hence it is deemed highly advisable that these precautions be taken, especially in horses and mules.

There is usually little or no swelling at the point operated upon. Where abscess occurs the operator is to blame. It means that pus-producing germs have been carried in upon the needle

and that either the needle or the skin was not disinfected. Abscess is more likely to occur in horses and mules than in other animals.

It has been the practice in Delaware to continue the vaccinated animals at their usual work. We have no data upon the subject showing this is unwise, but it is believed that the animals should be shielded as much as possible from excessive work and from extremes of heat or cold or from chilling rains. We advise our vaccinators, who consist of regular, practising veterinarians designated by the Governor upon the recommendation of the Board of Agriculture, to destroy all opened bottles of vaccine that remain unused at the end of a day's work, as it will certainly become contaminated and be spoiled if kept overnight at ordinary temperatures. The vaccine is dispensed in 50-dose bottles hermetically sealed and distinctively labelled, so there can be no mistake made in using it.

### *Effectiveness of the Method.*

The results of vaccination have been as good, as shown by our statistics, as those obtained by the use of any other biological product. That the method is entirely safe is shown by the fact that only one dangerous swelling has been brought to our notice in three years' experience in Delaware. Every year there are instances where, for some reason, animals that have been vaccinated die from anthrax, showing that they were not protected by the vaccine. No doubt some of these failures may be due to the animal being missed during vaccinating. In other cases the failure may be due to the vaccine needle not properly puncturing the skin, so that the vaccine falls upon the ground. These accidents are readily brought about when the animals are unruly. On the other hand, the writer has observed a case of anthrax that occurred in vaccinated animals—that is, where it was positively certain that the vaccine was properly prepared and active and had been properly applied.

Some cases of non-protection by vaccination can be explained by the fact that the vaccine itself was inert, and therefore non-protective. Cultures made from such vaccine failed to grow. The vaccine would, of course, fail in the usual physiological test for an anthrax vaccine, and, of course, would fail to protect the animal against anthrax. The writer has known of instances where for various reasons an animal would escape vaccination,

and that animal would be the only one to die on that farm. Hence he feels warranted in highly commending vaccination as the most important means of combating this terrible scourge. In France, where vaccination is most popular, and where statistics are reliable because of Governmental control, the death-rate before vaccination was adopted was, in cattle 5 per cent., and in sheep 10 per cent. After vaccination was adopted the losses were reduced to 0.34 per cent. in cattle and 0.94 per cent. in sheep. In Delaware the losses in 1907 in horses and cattle that were vaccinated were 0.32 per cent.

Vaccination should be practised every spring, at least a month before it is time to turn the animals out to pasture, as a month is required for the production of immunity. This vaccinating should not be optional with the owner, as at present, but should be compulsory, the State assuming the risk of loss from the use of vaccine, but not in those cases where it can be shown the animal died not from vaccination but from a natural infection, owing to failure of being protected by the vaccine, or from other causes.

### *A Test of Pasteur Vaccines.*

Along with the investigation of anthrax for the purpose of discovering new methods of treatment and prevention of the disease, and for studying the biology of the causative organism and the general sanitary aspects of the subject, it was decided to test the efficacy of freshly prepared Pasteur vaccines. It is believed that some of the bad results that have been reported as following the use of Pasteur vaccine is due to carelessness on the part of those preparing and using it. As there is no visible difference in the appearance of the two vaccines, Nos. 1 and 2, it is an easy matter to get the bottles mixed or improperly labelled. If the labels should come off the bottles, the vaccinator would have no guide as to which vaccine he was using. The writer has purchased anthrax vaccines on the open market, and has found some that were wholly inert and others that were too strong when tested in the usual way.

For the purpose of gaining such information as is possible from the practical experiences of practising veterinarians who vaccinate against anthrax in Delaware, the writer undertook to prepare Pasteur vaccines for the State Board of Agriculture, which were to be used as soon as possible after they had reached

destination. The cultures constituting the vaccines were grown in 50-dose bottles, each bottle containing 50 c.c. of bouillon which had been inoculated 24 hours previously with the vaccinal germs. The official vaccinator was furnished first with No. 1 vaccine. In 12 days he was shipped the No. 2 vaccine, for use on the same animals. Under this plan it was impossible for the bottles of vaccine to get mixed, even though the labels came off.

The plan of using fresh vaccine in which the germ is still in the bacillar stage was continued with good results for two seasons. For the last two years the plan of using vaccines that had been incubated for four or five days, or until the bacilli had spored, has been tried. This latter method represents the condition of vaccine as put on the market by commercial houses, and is a suspension of spores instead of bacilli. According to the experiences of these two seasons, we have reason to believe that the vaccine will remain active for several months, and such cultures may be prepared several months in advance of their use, provided the incubation is carried to a point where all growth ceases, or spores form. These spores inherit just that degree of strength possessed by their progenitors, and do not change except with a considerable lapse of time, possibly a year, if kept under favourable conditions. It is highly important that anaerobic conditions be not established in the bottles, as the bacilli will sink to the bottom and will not spore when grown anaerobically. To prevent this, it is important that the culture medium be made to reabsorb the air which has been driven out of it during sterilization before being inoculated with the vaccine germs. In preserving stock cultures of the vaccine it is very important that they be incubated for several days before being taken out of the incubator. If they are removed before spores have formed, the more vulnerable bacilli may succumb to existing unfavourable conditions. To these conditions may be ascribed the death of cultures of anthrax vaccine, and the loss of virulence of former virulent cultures of anthrax bacilli, which sometimes occur during the course of laboratory work.

### Experiments with Various Substances to Test Immunizing Powers.

Experiments upon the disease have been carried on uninterruptedly for the past three years. These had for their object the preparation of substances in the laboratory and in living animals

which could be used in combating anthrax by acting as antitoxins or bactericides, or as vaccines.

Realizing the great importance and economy in producing protective and curative substances in the laboratory over the necessarily expensive methods when employing animals for the same purposes, efforts have been made along the line of producing various culture products to be used in combating anthrax.

Pyocyanase, made after the method of Emmerich and Loew, gave some good results when tested upon rabbits, but failed upon sheep.

Anthraxase, prepared by the writer after the same general method used in producing pyocyanase, was without protective or curative properties, although it produced high fever when injected into rabbits and sheep subcutaneously.

Anthraxoin, consisting of a turbid suspension of dead anthrax bacilli, was apparently useless in protecting sheep against anthrax when used similarly to the Pasteur vaccine.

A single vaccine, having for its object the production of immunity in two weeks, and thus cutting down the necessary period by one half, was made by incubating a virulent bacillus for about 18 days at 42° to 43° C. Such a culture will kill guinea pigs in about a week, and in strength it thus holds a position between the two vaccines of Pasteur. With it sheep were vaccinated, and after 12 days withstood an otherwise fatal infection with virulent bacilli. In some cases, however, the immunity was not sufficiently strong, as was evidenced by the death, now and then, of a sheep when tested with virulent bacilli.

The preparation and use of the various substances, together with the results of the experimental work, are described in the following pages.

### *Anthraxin.*

Anthraxin was made similarly to tuberculin and mallein. The cultures of anthrax were grown for 10 days with daily shaking in glycerinated, peptonized bouillon, the glycerin being used in 4 per cent. strength. The cultures were then sterilized by boiling, filtered through Berkefeld filters, and then evaporated to one-tenth of the original volume. A sirupy liquid, much resembling tuberculin, resulted. It was tested on rabbits and sheep for immunizing properties.

From the experiments we gather that anthraxin was possessed of no immunizing properties whatever.

*Pyocyanase.*

Pyocyanase, the next substance experimented with, was prepared as follows: Large flasks of medium were inoculated with *Bacillus pyocyaneus* and grown at 37° C. until a ropy condition was produced, which required three weeks, the flasks meanwhile being shaken daily. The composition of the medium was as follows: Peptone, 0.5 per cent.; glycerine, 0.1 per cent.; dipotassium phosphate, 0.1 per cent.; magnesium sulphate, 0.01 per cent.; sodium chloride, 0.3 per cent.; sodium bicarbonate, 0.1 per cent.; in distilled water (synthetic medium of Emmerich and Loew). When growth had ceased in this medium the growths from a number of agar-agar cultures of the same organism were added, and the whole was thoroughly shaken. The culture medium was then neutralized with dilute hydrochloric acid. Carbolic acid was then added to 0.2 per cent. strength as a preservative. The liquid was then evaporated down to one-tenth of its original volume at ordinary room temperature by being placed in pie plates. Then the liquid was dialyzed for 24 hours in running water, filtered through Berkefeld filters, and 0.2 per cent. carbolic acid was again added to replace that which was dialyzed out. The resulting liquid, pyocyanase, has a dark coffee colour and a pungent odour. The experiments to test its immunizing and curative properties were performed upon guinea pigs, rabbits, and sheep.

One series of experiments was made with unfiltered pyocyanase. The dead bacilli produce abscesses at points of injection and frequently disease of the liver, which contributed to death from anthrax.

By a series of experiments with filtered pyocyanase it was proved that when given in proper dose and simultaneously with virulent anthrax bacilli, the period of inoculation is greatly lengthened in rabbits. Sheep, however, seem to be very susceptible to poisoning by pyocyanase, and no immunity is conferred upon them by its use.

*Anthraxase.*

Anthraxase was made in about the same manner as pyocyanase, except that the *Bacillus anthracis* was substituted for *Bacillus pyocyaneus*. The tests of this substance include cultures

grown in ordinary bouillon, cultures grown in Emmerich and Loew's medium, and experiments with precipitated anthraxase. In each case it was found to be practically useless.

### *Anthraxoin.*

Anthraxoin was prepared and experimented with as follows: It consists essentially of a suspension, in carbolized normal salt solution, of dead, sporeless, anthrax bacilli. It was produced by inoculating, from a fresh anthrax carcase, bottles that had been filled completely with nutrient bouillon and plugged with hardest paraffin stoppers. In this way none but sporeless bacilli were introduced, and under the existing anaerobic conditions no spores could form. After all growth had ceased, at 35° C., these cultures were completely immersed in a water bath maintained at 55° C. for one hour, which was sufficient to devitalize the bacilli but not to destroy any antibodies they might contain. The dead bacilli were separated by filtration from the liquid in which they had grown, and those adhering to the Berkefeld filter were washed off in the requisite amount of carbolized normal salt solution. The suspension experimented with consisted of the bacilli that grew in 2,500 c.c. of bouillon, suspended in 50 c.c. of carbolized normal sodium chloride solution. It was found as the result of the experiments to be practically useless.

### *A Commercial Vaccine in Pill Form.*

A commercial vaccine which, according to the makers, consists of dead anthrax organisms in pill form was also tested. These small pills are placed under the skin by means of a trocar and are claimed by the makers to produce immunity to anthrax. Microscopic examination, as well as cultural and animal experiments, show that the claims of the makers, in so far as the vaccine being dead and harmless is concerned, are true. One can easily see with the microscope that these little pills consist of dead anthrax bacilli and their spores held together in pill form by a proper excipient. The writer was unable, however, to verify the claim that they produce any immunity. A rabbit succumbed in six days, but as it is very rarely that a rabbit can be immunized by a vaccine, a sheep, which animal is easily protected, was also employed, with negative results.

PREPARATION OF AN EFFECTIVE SINGLE VACCINE.

The single vaccine, like Pasteur vaccine, consists of cultures of attenuated anthrax bacilli, the only difference being in the degree of attenuation and that, as its name implies, it is applied only once, thus requiring a shorter time and only one handling of the animals.

To prepare such a vaccine or attenuated culture, the virulence of an already virulent culture of anthrax was exalted by passage through very young animals. A strain can in this way be produced which will kill a sucking rabbit in twenty-four hours. From the heart's blood of such a carcase tubes of bouillon are inoculated immediately after death. These cultures are then incubated at 42° to 43° C. for varying periods of time—from twelve to eighteen days. On the twelfth day a subculture is made from one of the tubes and cultivated at 35° C. On the thirteenth and succeeding days subcultures are made from the remaining tubes until the series has been completed. These six subcultures of attenuated bacilli are now tested on guinea pigs and rabbits, and on sheep if possible.

More dependence is to be placed upon the animal test than upon the number of days the attenuation process is carried on. A culture of proper strength is generally obtained from tubes that have been attenuated for about 16 days. The proper culture will be one which will not kill rabbits, but which will kill a majority of guinea-pigs in a delayed period, say 5 or six days. Such an animal should show no swelling at the point of inoculation, and the bacilli should be found only sparingly in the internal organs. When shaken in cultures such a vaccine shows a homogeneous clouding of the medium; no flocculi persisting, as occurs in virulent cultures.

As rabbits and guinea-pigs cannot be made immune to anthrax by vaccination of this kind, these animals are only useful in testing the pathogenesis of the cultures. For testing the immunizing property, sheep, which are easily immunized, were employed. Quite a number of sheep were used in the experiment to produce a safe, efficient single vaccine, and as regards the failures along this line, it is only necessary to say that they were entirely due to improper attenuation of the cultures. When the proper attenuation was reached there was no difficulty in immunizing animals by a single vaccination. This was effective

against a subsequent, otherwise mortal dose of virulent anthrax bacilli, as the following experiments will show.

*Tests of the Single Vaccine.*

*Experiment No.* 1.—On April 15, 1909, a visibly pregnant cow was given subcutaneously 1 c.c. of single vaccine. She showed no ill effects whatever from the injection. On May 1 the animal was inoculated with 0.2 c.c. of virulent anthrax bacilli from a 24-hour culture which killed a check rabbit and a check cow in 48 hours. On May 19 the cow dropped a fully developed calf which when found was dead, lying with its head bent under the shoulder. Supposing that the calf had been asphyxiated, it and the membranes were buried. However, a platinum loop full of the discharge was plated and a pure culture of 60,000 anthrax bacilli was obtained. A guinea-pig inoculated with a culture made from one of these colonies died of anthrax in 48 hours. The cow remained well, and subsequent daily cultivations from vaginal discharges showed no anthrax bacilli.

This experiment was extremely valuable, not only as showing that the cow had been immunized by a single vaccination, but also for showing not only that anthrax can be communicated to the fœtus, but that it can be thus communicated by an immune mother. It also showed that anthrax bacilli may persist for at least 18 days in the body of an immune animal. When the cow was destroyed for various reasons on May 25 she was in perfect health, and cultures and inoculations made with her blood showed no anthrax bacilli present. It is to be regretted that this animal could not have been kept for further observations and experiments.

*Experiment No.* 2.—On September 14, 1909, two sheep were vaccinated with single vaccine, each receiving 1 c.c., and showed no sickness therefrom. On September 28 each sheep was inoculated subcutaneously with 0.2 c.c. of a culture of anthrax bacilli whose virulence had been proved on a rabbit in the same experiment. The sheep at no time showed any sickness. On November 2 both sheep were again tested with virulent bacilli and showed no sickness.

*Experiment No.* 3.—On November 12, 1909, three sheep were vaccinated with 1 c.c. of single vaccine and showed no sickness therefrom. On November 27 one of the animals was tested

with 0.2 c.c. of virulent bacilli, and on December 1 the other two were similarly tested. They at no time showed any sickness. These three sheep, together with the two used in experiment No. 2, were used later in experiments to produce an antibacterial serum.

*A Serum for Producing Immediate Immunity.*

Although the favourable results from vaccination by the Pasteur system have been known for a long time, and owing to the cheapness of the vaccine it would seem that there is nothing more to be desired, the length of time required to produce immunity is one drawback in its use when one is endeavouring to check an existing outbreak of the disease. When vaccination is practised a month in advance of the animals being turned out to pasture in the spring, the system of Pasteur vaccination is the proper one to use. In existing outbreaks, however, it is evident that any system that requires a month to become protective leaves much to be desired, as many animals could become infected and die before protection could be afforded them.

With the end in view of devising a method whereby an immediate immunity could be established in existing outbreaks or where an immunity could be brought about in a much shorter time than has been possible under the old system of vaccination, the writer has devoted a large portion of his time for the past three years. As it had been conclusively demonstrated that animals can be immunized by a single vaccine, thus cutting down one-half the period necessary for immunization by the old system of Pasteur, it was decided to experiment upon the production of an antianthrax serum by endeavouring to hyperimmunize sheep after the manner of the production of anti-hog-cholera serum, with the exception that whereas in the latter work virulent blood was used, this was precluded in our experiments owing to the dangers attending the handling of large quantities of virulent anthrax blood. Instead, the blood used was that drawn from an animal immune to anthrax, and not from one sick with anthrax.

Briefly stated, the writer has produced an antibacterial serum by highly immunizing sheep through repeated inoculations, first of attenuated anthrax bacilli, and following these by inoculations

of the most virulent races of the bacilli in increasing doses until the animal would withstand with impunity fifty thousand times the minimal lethal dose. Such a serum will protect a sheep against an otherwise mortal dose of bacilli and produce an immediate immunity. It is, therefore, a very valuable adjunct in working against the spread of the disease in existing outbreaks where the usual vaccination is becoming practised. The serum will confer a passive immunity immediately, and thus protect the animal against fatal infection until the vaccine confers an active immunity. And should an animal which has been protected by the serum become infected with a virulent anthrax bacillus, the results of this infection will be the production of a much stronger immunity than the vaccine and serum would otherwise confer.

It is evident that if a single vaccine, or even a double vaccine, can be used in conjunction with an antibacterial serum to produce immediate passive immunity which will persist until the vaccine has had time to bring about active immunity, a long step will have been made in controlling this formidable disease. The experiments with this end in view were carried out upon sheep as follows:—

*Experiments with the Serum.*

*Experiment No.* 1.—On December 15, 1909, a sheep immunized with single vaccine and a subsequent inoculation with virulent bacilli (see Experiments Nos. 2 and 3 with single vaccine) was bled from the carotid artery—the femoral artery being small and deep-seated—by means of a glass cannula and rubber tubing. When the blood had clotted, 500 c.c. of serum were decanted and injected into the inguinal regions of another sheep which had been similarly immunized. Microscopic examinations and inoculations into guinea pigs of this blood showed it to be free of anthrax bacilli. The injected sheep was lame in both hind legs the next day, but this lameness disappeared when the complete absorption of the injected blood had taken place, and no abscess formed. On January 12 this sheep was bled from the carotid artery, and when the serum was collected it was preserved by adding to it one part of a 5 per cent. solution of carbolic acid to each nine parts of serum. In making this addition of carbolic acid some coagulation will occur if the

preservative and serum be not poured simultaneously into another vessel and stirred by a helper.

The above serum was without protective properties. All animals upon which it was used died of anthrax, as follows:—

On January 13, 1910, 12 guinea pigs received increasing doses of serum from 0.1 up to 3 c.c. and simultaneously 0.1 c.c. of virulent anthrax culture. All of these animals died of anthrax in forty-eight hours.

On January 17, 1910, the amounts of serum were increased to 4 c.c., 5 c.c., 6 c.c., 7 c.c., 8 c.c., 9 c.c., and 10 c.c., with a simultaneous dose of 0.1 c.c. of virulent culture. The 7 animals thus tested also died in forty-eight hours.

On February 5, 1910, a sheep received simultaneously 24 c.c.. of the serum and 0.2 c.c. of virulent culture. A control rabbit died in forty-eight hours and the sheep died of anthrax in three days.

On February 9, 10, and 11 another sheep received daily 12 c.c. of the serum and on the 12th a test dose of virulent bacilli. This sheep lived four days and then died of anthrax.

These experiments demonstrated that the modified hog-cholera method of serum production could not be applied to anthrax, and it was then decided to try and bring about hyperimmunization by increasing doses of virulent bacilli repeated over a long period. The two sheep used in Experiment No. 2 with single vaccine were employed for this purpose as follows:—

*Experiment No.* 2.—On September 14, 1909, two sheep were vaccinated with 1 c.c. of single vaccine. On September 28 they were given a test dose of 0.2 c.c. of virulent bacilli, and remained well, while a check rabbit died in forty-eight hours. On November 2 each sheep again received 0.2 c.c. of virulent bacilli. On March 4, 1910, each sheep received 0.3 c.c. of virulent bacilli. On March 18 they received 1 c.c. of virulent bacilli, and on April 2 each sheep received 5 c.c. of virulent bacilli. A period of about seven months was thus consumed.

On April 14, 1910, these sheep were bled from the carotid artery, producing 1,900 c.c. of serum, to which was added one part of a 5 per cent. solution of carbolic acid to each nine parts of serum as a preservative. Prior to the addition of the preservative tests for the presence of anthrax bacilli were made upon guinea pigs and by plate cultures. None were found.

This serum was used upon sheep in connection with virulent anthrax bacilli as shown in the following table:—

TABLE.—EXPERIMENTS WITH ANTIANTHRAX SERUM.

| Animal | Date | Injections | | Results and remarks |
|---|---|---|---|---|
| | | Immune serum | Virulent culture | |
| Sheep 17... | Apr. 29 | 5 c.c. subcutaneous | 0.2 c.c. subcutaneous ... | — |
| | May 16 | ... ... ... | .2 ,, ,, ... | Sheep remains well. |
| Rabbit (control) | ,, | ... ... ... | .1 ,, ,, ... | Rabbit dies in 48 hours. |
| Sheep 18... | May 21 | 10 c.c. subcutaneous | .1 ,, ,, ... | Not sick. |
| | June 20 | ,, ,, | .2 ,, ,, ... | No bad result. |
| | July 6 | ,, ,, | .5 ,, ,, ... | Remained well. |
| Rabbit (control) | May 21 | ... ... ... | .1 ,, virulent culture... | Died in 48 hours. |
| Sheep 19... | May 24 | 10 c.c. subcutaneous | .1 ,, subcutaneous ... | — |
| | June 20 | ,, ,, | .1 ,, ,, ... | Remained well. |
| | July 6 | ,, ,, | .5 ,, ,, ... | — |
| Rabbit (control) | May 24 | ... ... ... | .1 ,, virulent culture... | Died in 48 hours. |
| Sheep 20... | May 27 | ... ... ... | .5 ,, single vaccine ... | — |
| | June 20 | 10 c.c. subcutaneous | .1 ,, virulent culture... | — |
| | July 6 | ,, ,, | .5 ,, ,, ... | Remained well. |
| Sheep 21... | May 27 | ... ... ... | .5 ,, single vaccine ... | — |
| | June 20 | 10 c.c. subcutaneous | .1 ,, virulent culture... | Remained well. |
| | July 6 | ,, ,, | .5 ,, ,, ... | — |
| Rabbit (control) | June 20 | ... ... ... | .1 ,, ,, ... | Dead in 48 hours. |
| Sheep 22... | June 1 | 5 c.c. subcutaneous | 1.0 ,, single vaccine ... | — |
| | ,, 18 | 10 ,, ,, | .1 ,, virulent culture... | Remained well. |
| | July 6 | 10 ,, ,, | .5 ,, ,, ... | — |
| Sheep 23... | June 1 | 5 c.c. subcutaneous | 1.0 ,, single vaccine ... | — |
| | ,, 18 | 10 ,, ,, | .5 ,, virulent culture... | Remained well. |
| | July 6 | 10 ,, ,, | .5 ,, ,, ... | — |
| Sheep 24... | June 1 | 5 c.c. subcutaneous | 1.0 ,, single vaccine ... | — |
| | ,, 18 | 10 ,, ,, | .1 ,, virulent culture... | Remained well. |
| | July 6 | 10 ,, ,, | .5 ,, ,, ... | — |
| Sheep 25 (control) | June 18 | ... ... ... | .1 ,, ,, ... | Died of anthrax in 48 hours (control for sheep 22, 23, and 24, for inoculations June 18). |
| Rabbit (control) | July 6 | ... ... ... | .1 ,, ,, ... | Died of anthrax in 48 hours (control for sheep 22, 23, and 24, for inoculations on July 6). |

No doubt the period of time occupied in hyperimmunizing the sheep which produced this highly protective serum can be very much lessened—probably one-half. It will be noted that the time covered was about seven months. This was not intentional, but as the sheep had already been immunized for another object, and not used, it was decided to carry out the idea of

greatly increasing their immunity by the method followed. It will be seen by referring to the table that an idle period of about three months elapsed between November, 1909, and February, 1910, which might just as well have been employed for this purpose. It is also possible that by giving larger doses of virulent bacilli the immunizing property of the serum may be considerably increased.

That the degree of immunity can be established by the number of inoculations and the quantity of virulent culture used was clearly shown in sheep Nos. 18, 19, 20, 21, 22, 23, and 24. They had received three injections of serum and three inoculations with bacilli, in very small doses, and while they themselves were immune (see table) their blood, when tested after slaughter on July 18, did not protect other sheep.

It is also highly probable that sheep will produce a more effective antianthrax serum for their own species, and cattle for cattle, horses for horses, &c.; that is, the sera should be homologous. However, no effort was made to test this principle, as the great expense attending such experiments precluded their being carried out.

### *Conclusion.*

The writer does not advise the abandonment of the old Pasteur system of vaccination against anthrax when it is practised upon animals before they are turned out on the pastures in the spring of the year. When animals are dying, however, vaccination alone requires too long a period to protect, and it is in these outbreaks that the antianthrax serum should be used in conjunction with vaccine. The experiments have shown that a single vaccine may be used with good results. Where it is desired, however, the serum may be used simultaneously with the double vaccine or with a single vaccine.

# PYÆMIC HEPATITIS AFFECTING SHEEP.

By J. A. GILRUTH, D.V.Sc., M.R.C.V.S., F.R.S.E.
*Professor of Veterinary Pathology, University of Melbourne.*

An epidemic of this disease which, so far as I am aware, has hitherto been undescribed in sheep was brought under notice by Mr. W. A. Kendall, G.M.V.C. The cases occurred in a valuable stud flock of merinos. The disease was confined to sheep grazing in two paddocks and appeared only in those which had been bought in another State. A number of sheep succumbed, and according to the owner all were similarly affected. The animals were all in fair condition, and no definite symptoms appear to have been manifested before death.

According to the owner's account to Mr. Kendall the only internal organ which showed distinct evidence of disease was the liver, and it was this organ, from one of the last cases to occur, which had been brought for Mr. Kendall's opinion, that I had an opportunity of examining.

To the naked eye the organ was enlarged, dark in colour, congested, and thickly studded throughout, but especially under the capsule with spherical, greyish-yellow nodules, varying in size from a pin-head and even smaller, to that of a split-pea. These areas were so numerous that the surface of the liver on section in any plane showed from 3 to 6 per sq. in. visible to the naked eye. Each nodule was composed of homogeneous material, dense in consistency and firmly adherent to the liver substance.

Microscopical examination of smears showed that these "tubercles" were composed of degenerating pus cells, with masses of bipolar staining, Gram-negative, short double bacilli.

The hepatic lymphatic glands were enlarged, congested, and thickly studded with similar tubercles to those observed throughout the liver.

*Microscopical Examination of Hepatic Lesions.*—Sections of liver show the organ to be affected with early biliary cirrhosis (probably due to a previous attack of distomatosis, a common affection of Victorian sheep). There is congestion of the portal capillaries, and scattered thickly throughout the parenchyma are minute spherical areas composed of white blood corpuscles, chiefly polymorphs, the centre of each consisting of granular débris amongst which are masses of the cocco-bacilli described.

The "tubercles" of the hepatic lymph glands show histologically the same structure.

*The Pathogenic Organism.*—The bacillus was readily isolated in a pure state and proved to have all the characters of a coccobacillus of the *Pasteurella* group being non-motile, Gram negative, growing readily and characteristically on ordinary media, but not on potato, not liquefying gelatine, and not curdling milk. The tendency for the organisms in cultures to assume an almost spherical shape, and the appearance of involution forms further justification for the inclusion of the bacillus amongst the *Pasteurellæ*. It should be observed, however, that the colonies on ordinary agar slopes are smaller than those of the chicken cholera bacillus, and further, that the growth on ordinary broth is rather granular, and within forty-eight hours forms a deposit, leaving the liquid clear.

*Experiments.*—A lamb and a two-year-old cross-bred sheep inoculated subcutaneously with 2 c.c. broth culture of the bacillus, showed slight evidence of general disturbance for a week, the temperature varying between 104.6 and 106.6, with localized inflammatory swelling at the seat of inoculation. The swelling gradually subsided, however, and on slaughter the one four weeks, the other six weeks later, the only lesion observed was the presence of a caseo-purulent irregular mass at the inoculated region, the internal organs being normal. In these lesions the bacilli were numerous, and therefore growths were readily obtained on artificial media.

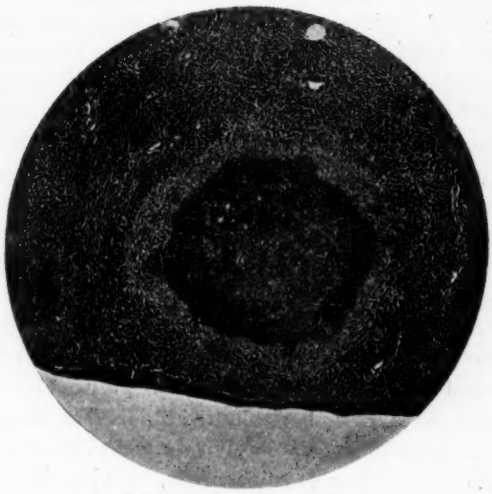
An aged sheep fed with 5 c.c. of broth culture remained normal, and on slaughter two months later showed no evidence of liver or other infection.

Although sheep, at least cross-breds as these were, failed to develop lesions similar to those observed in the livers of the original cases, it was otherwise with rabbits and guinea-pigs.

A rabbit inoculated with ½ c.c. broth sub-culture died seven days later without previously exhibiting any definite symptoms of illness beyond a slight localized swelling where the injection was made in the thigh. *Post-mortem* examination disclosed a large irregular subcutaneous caseo-purulent area, infiltrating the muscles, which were pale and degenerated. The liver was congested, and thickly studded with enormous numbers of very minute "tubercles" not exceeding a small pin's head in size.

and distributed very uniformly throughout the organ. The spleen was enlarged, pulpy, and "tubercles" similar to those in the liver were disseminated throughout. A few "tubercles" were present in the cortex of each kidney. The pelvic glands were caseous, but otherwise the body was normal. The consistence and microscopic appearance of the hepatic and splenic nodules were identical with those seen in the sheep, and all contained masses of the characteristic bacilli.

*A Guinea-pig* (29) inoculated with ½ c.c. broth sub-culture died fourteen days later without previously exhibiting any definite symptoms beyond the development of an abscess, which had spontaneously ruptured.



Pyæmic hepatitis. ×58.

On *post mortem* a large irregular caseous area was seen situated subcutaneously extending upwards to the pubis; the precrural lymphatic glands enlarged and caseous. Abdomen distended by a large quantity of clear semi-gelatinous effusion. Liver greatly enlarged, congested, and studded with numerous small caseous "tubercles" varying in size from a point to a pin's head. In addition the organ at the edges and on patches of posterior surface was covered with a greyish false membrane, causing adhesions between the organ and diaphragm. Spleen enlarged to over twice the normal size and showing many

"tubercles" similar to those in liver; fibrinous adhesions between stomach, liver and spleen. Kidneys congested. Thoracic cavity—small quantity of slightly blood-tinged serous effusion with a small patch of pleurisy on left lung. Lungs at base hepatised with small nodules of commencing degeneration.

Another guinea-pig (30) inoculated with ½ c.c. died on the twelfth day. In this case there was a greater quantity of caseo-purulent material at the seat of inoculation, and in addition there was much gelatinous œdema infiltrating the whole tissues of the limb and implicating the abdominal wall. Peritonitis, especially of the parietal surface, characterized by a papular eruption, and adhesions existed between the colon and the abdominal wall. The liver and spleen were mottled with numerous small "tubercles," both organs being congested. The lungs in this case were also implicated, exhibiting several small caseous "tubercles" surrounded by an inflammatory zone. The whole *post-mortem* picture was very characteristic of a guinea-pig infected experimentally with the bacillus of bubonic plague.

Another guinea-pig (82) inoculated with 0.25 c.c. of a subculture from the previous guinea-pig (30) developed a large caseo-purulent swelling which ruptured and partially healed. Death, however, occurred eight-four days after inoculation. *Post-mortem* examination showed that the disease had spread slowly; the inguinal, precrural, and sacral glands were greatly enlarged and completely caseous. The peritoneal cavity contained about 30 c.c. of amber-coloured fluid. The liver was much enlarged, congested, and intensely mottled with enormous numbers of small irregular caseous areas, varying in size from a pin's head to a split pea. The spleen was similarly affected and much enlarged, measuring 1½ in. in length by ¾ in. in breadth. The lung showed patches of catarrhal pneumonia with small areas of degeneration.

From all these experimental cases the cocco-bacillus was readily isolated.

*General.*—It is more than probable that the originally infected sheep may have exhibited nodules (similar to those seen in the liver and hepatic glands) in other organs such as the spleen, kidneys, and even lungs, and it is to be regretted a careful and complete *post-mortem* examination of a number of affected sheep could not have been made. The appearance of the liver

was so striking, however, that one can readily understand a less severe infection of other organs being readily overlooked by the untrained observer.

Although experiments failed to reproduce these lesions in sheep, the evidence adduced from experiments on rabbits and guinea-pigs clearly prove that the lesions were due to the cocco-bacillus which was so abundant and so readily isolated. The distribution of micro-organisms of the pasteurella group is so wide in nature, and their saprophytic nature, together with the fact that under certain ill-understood conditions they may become pathogenic for any animal is so well recognized, that one has no hesitation in concluding that the disease under review originated through an ordinary saprophytic organism becoming pathogenic.

The deaths all occurred within a few weeks of each other, when the mortality ceased and for months there has been no recrudescence.

Further, I am advised by the owner that although a number of sheep of the same flock have been killed for home use, no similar lesions in the liver or other organs have been observed, and as it was the station butcher who originally detected the hepatic lesions, it may be concluded he would have readily observed a similar condition in other sheep.

Though experiments on sheep failed to produce the hepatic lesions it is possible that had they been conducted on sheep of the same breed more success might have attended them. Unfortunately this point was not considered early enough for experiments to be conducted on these lines.

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## UNIVERSITY OF LONDON.

### Preliminary Examination in Veterinary Science for Internal and External Students.

*Examiners*: Inorganic Chemistry: J. A. Gardner, Esq., M.A., H. R. Le Sueur, Esq., D.Sc., J. E. Purvis, Esq., M.A., and John Wade, Esq., D.Sc. Physics: J. H. Brinkworth, Esq., B.Sc., A. H. Fison, Esq., D.Sc., F. Horton, Esq., D.Sc., M.Sc., M.A., A. W. Porter, Esq., B.Sc., and Professor F. Womack, M.B., B.Sc.

### Pass List, July, 1911.

3901. Andrews, Francis John.....Royal Veterinary College.
3903. Pugmire, Harold.....Private study.

# Clinical Articles.

## THE DIAGNOSIS OF AFRICAN COAST FEVER. GLAND PUNCTURE.

By L. E. W. BEVAN, M.R.C.V.S.,
*Government Veterinary Bacteriologist, Salisbury, Rhodesia.*

The diagnosis of African Coast fever may be based on (1) the presence of the parasite (*Theileria parvum*) in the red blood cells; (2) the so-called Koch's bodies in the glands, spleen and other organs.

While other parasites closely resemble *T. parvum*, Koch's bodies are diagnostic of African Coast fever, and being an early stage in the life cycle of the parasites, are met with in the gland and spleen some days before *T. parvum* can be detected in the blood.

It is often of the greatest importance that an early decision shall be arrived at as to whether an animal is suffering from the disease, and valuable time may be saved by forwarding gland smears as well as blood smears for diagnosis by microscopic examination at the Veterinary Laboratory, Salisbury.

The animal having been secured against a fence, the head should be drawn round towards the operator, who stands on the left side, and seizes with his left hand the large gland in front of the shoulder. The hair over the gland is removed and the area is washed with an antiseptic and dried. Holding the gland firmly imprisoned under the skin, the operator introduces the needle of a hypodermic syringe into it from below upwards, and, attaching the barrel of the syringe, draws up the gland juice by withdrawing the piston. For this purpose it is advisable to use a needle having a large bore. With some animals it is somewhat difficult to manipulate the syringe single-handed, and it may be found easier to attach a piece of rubber tubing to the needle exerting suction from the mouth.

If the animal is too wild or restless it may be necessary to throw it, and to operate upon the gland of the flank which lies slightly above and in front of the point of the stifle.

The substance removed should then be placed on a clean microscopic glass slide and spread after the manner of a blood-film. The wound should then be washed with antiseptic, and usually heals rapidly.

When no apparatus is available very little damage is done by cutting boldly into the gland and removing some gland substance by scraping with the point of the knife.

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## EQUINE MELANO-PSAMMOMATA OF THE ENCEPHALON.

By W. M. SCOTT, F.R.C.V.S.
*Bridgwater.*

On July 1, 1910, at 10 P.M. my assistant was called to see an aged grey mare.

*History.*—Previous health record was excellent. On the day of illness she had done her usual work without any apparent discomfort.

*Symptoms.*—These came on somewhat suddenly. She became very restless and broke into a profuse perspiration. Nervous manifestations showed themselves, in extreme irritability, shaking and tossing of the head, knocking it against the wall, boring it in the corner, pawing, biting the woodwork, running backwards and alternated by going round the box at a rapid pace, grinding the teeth, foaming at the mouth, in fact, nearly every conceivable brain symptom was in evidence. The mucous membranes were deeply injected, almost cyanotic, pulse rapid and full, heart's action "hammering." Temp. 104.1° F. The pupils were widely dilated and the retinal vessels distended. Following upon the exhaustion the hyperæmic cerebral symptoms would subside at intervals and their place be taken by depression and coma.

*Diagnosis.*—Cerebral hyperæmia and probably encephalitis. Cause partly thermic, partly exertion.

On July 2 the acute symptoms had subsided and partial paresis had taken place. The head was dropped, the erectile muscles of the left ear and partly the right were paralysed, the lower lip was pendulous, the muscles of mastication and deglutition were completely paralysed. Labial prehension was also in abeyance, although the appetite to eat was acute. The eyes were dull, and amaurosis appeared to be complete. Locomotion was difficult and gait staggering.

She remained in this semi-comatose state until the 6th, when the muscles of the jaws gave evidence of activity. She also began to suck up liquids and swallow, although with difficulty, some of the fluids returning through the

nose. Progress was slow but satisfactory, and a gradual return of hyperæmia took place. This condition gradually disappeared under treatment, and on July 29 she was sent to work looking as fit and well as usual. This satisfactory condition continued until April 8, 1911, when a recurrence took place, but this time the hyperæmia seemed more passive and less acute than the previous attack.

The most constant symptom now was the continual walking round in a circle and always in the same direction, *i.e.*, opposite to the sun's circuit. On the 13th she died.

*Treatment of First Illness.*—At the outset venesection was performed, and a dose of aloin et calomel given. The box was darkened, the walls padded and a continual application of cold water to the poll was ordered. Full doses of aconite and pot. brom. were administered, and at a later date these were replaced by small doses of hyd. iod. rub. et strychnini. In addition, she had several subcutaneous injections of normal saline solution, and during her last illness her blood was washed with 2 gals. of sea water.*

*Post-mortem.*—The case was many miles away and we had to be content with the head and neck sent to us for examination.

The basilar artery was disended in places, giving a varicose appearance, and the walls were comparatively hard and gritty when cut; probably calcareous degeneration had set in. Between the bifurcation of the basilar artery and the branching of the internal carotids a semi-organised blood clot was detected. As would be expected, the meninges contained an excessive quantity of fluid.

The right and left hemispheres of the cerebellum contained an oval-shaped neoplasm; the right weighing 3¼ oz., the left 2 oz. They were dark grey in colour with a glistening surface. On section the tumours varied in colour from dark grey to black, the

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* [As a great believer in the beneficial effects of the injection of normal saline solution, particularly in equine practice, I have practised it for many years. Some two years ago I had a case near the sea, and being desirous of using saline solution, ordered some salt, which we found somewhat dirty. I had a gallon of clean sea water collected and used it instead. Since then, as opportunities occur, we use sea water.

I was rather amused the other day to read in the lay press a descriptive article headed "The '*New*' Treatment by the Injection of Sea Water." But contrary to the directions of that article we neither go out ten miles to collect the water nor use sterilized vessels and have had no untoward results.]

surface being pointed and variegated in appearance. On squeezing an inky-coloured fluid escaped. Against the edge of the knife they gave a gritty feel suggestive of the advanced stages of cholesteatomata.

The horse, I understand, was becoming lighter in colour, but there were no melanotic growths round the anus or other visible regions. I regret a general *post-mortem* was not made.

That the neoplasms had a great deal to do in interfering with the cerebral circulation no one will gainsay, but I have found these neoplasms in the brains of horses which have died from causes other than cerebral, and it only goes to show how accommodating such a delicate structure as the brain is provided it is given ample time to fit itself to its surroundings.

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## KERATOMA, RESULTING FROM A PICKED-UP NAIL.

By Captain A. J. WILLIAMS, F.R.C.V.S., A.V.C.
*Mounted Infantry School, Longmoor.*

*Subject.*—A mounted infantry cob, age 16 years.

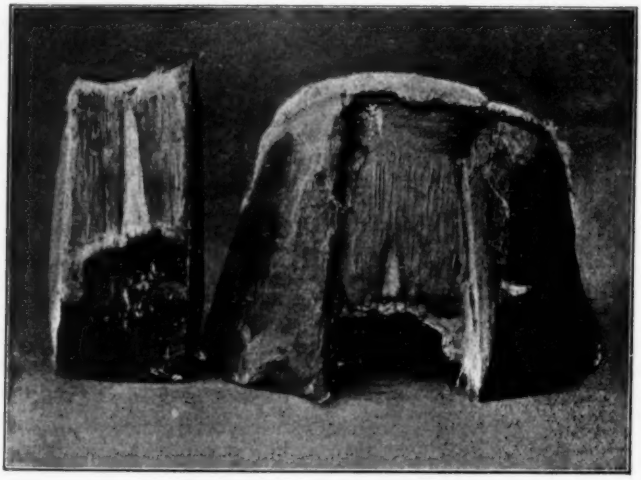
*History, etc.*—Admitted for treatment on September 4, 1908, suffering from a punctured wound of the near hind foot, caused by a picked-up nail.

Ordinary treatment was carried out, and the animal was sound and sent to work in eighteen days. On January 2, 1910, he was re-admitted, showing suppuration at the seat of the original injury. The affected part was opened up, antiseptic treatment carried out, and the animal was sent to duty on February 27, 1910. The affected part appeared quite sound when the animal was discharged. May 1, 1910.—Very lame again; the sole immediately in front of the frog was under-run at the seat of the previous injury. The horn was discoloured for a considerable distance. I removed the diseased horn from an area of about three inches, and prescribed antiseptic foot baths and antiseptic after treatment. Discharged to duty on June 15, 1910.

On July 26, 1910, lameness reappeared, and from this date to July 10, 1911, the animal was under treatment for 150 days, extending over five periods. Each time there was lameness and suppuration when admitted. The affected part would heal up and appear sound, but after varying intervals suppuration recurred. On June 20, 1911, the animal was cast and the foot

opened up, cocaine and adrenalin being used. After opening up for some distance a hard portion of laminæ was found, pointing to a diseased condition of the laminæ, probably extending to the coronary region. As it would necessitate removing a section of the wall from the coronary band to the toe, in order to effect any permanent result, followed by some months' after treatment, the animal was destroyed, not being worth treatment.

*Post-mortem* examination revealed a keratoma growing from the horny laminæ and extending from the sole to immediately below the cutigeral groove, with a cavity running up the centre of the growth.



Keratoma.

*Remarks.*—There was no external evidence of the growth; the wall showed no bulging or any alteration from normal.

At one period, in April of this year, there was suppuration at the coronet in a direct line with the diseased area at the toe. This quickly yielded to treatment; it was the only occasion upon which there was any indication of the disease extending so far up the hoof.

It is interesting to note that 16 months elapsed from the time of the original injury to the next admission for treatment.

I am much indebted to Major A. C. Newsom, A.V.C., Army Veterinary School, Aldershot, for the excellent photograph.

## NOTE ON THE PRESENCE OF SCLEROSTOMA EQUINUM IN THE LIVER.

By Captain A. J. WILLIAMS, F.R.C.V.S., A.V.C.
*Mounted Infantry School, Longmoor.*

Some time ago, when making a *post-mortem* examination on a case of fracture of the cranium, I came across the following conditions:—

The liver was the seat of a localized perihepatitis, and was adherent to the diaphragm. The affected area showed parasitic invasion; parasites present under the capsule and in the liver substance, which was softened where they were lodged and cirrhotic in the vicinity.

Portions of the parasitic tracts were filled with calcareous material and a purulent matter. There was a number of ovoid thick walled cysts between the lobes, and on pressing them sclerostomes escaped with some purulent material.

Specimens were sent to Dr. Stevens, Liverpool Tropical School, who very kindly examined them and also forwarded them to Professor Loos for opinion. Dr. Stevens informed me that they were probably immature sclerostomes, the doubt arising from the fact that they were immature.

The horse has a weaver. I have often wondered whether the chronic liver lesions causing fixation of the organ to the diaphragm and setting up chronic irritation had any connection with the symptoms known as weaving.

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## FRACTURE OF THE FIFTH AND SIXTH LUMBAR VERTEBRÆ.

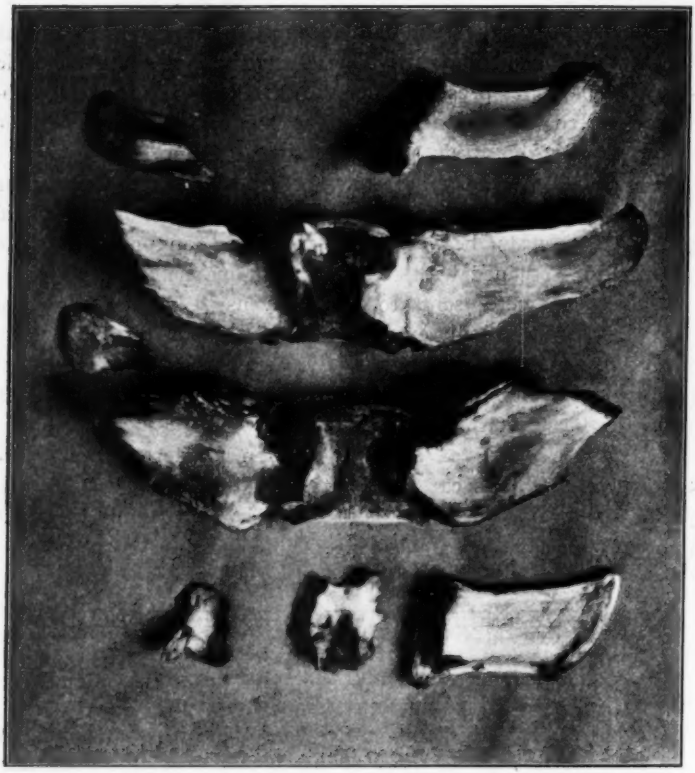
By Captain A. J. WILLIAMS, F.R.C.V.S., A.V.C.
*Mounted Infantry School, Longmoor.*

The subject of this note, a five-year-old cob, was running in a point-to-point race last April; just before coming to the penultimate jump he dropped his hind legs in a small ditch, fell heavily, and was unable to rise for a little while.

I found the animal on his feet, showing signs of considerable pain, and the near hind leg held off the ground. On moving him forward for a few steps he could put a little weight on the near hind leg. There was occasional knuckling over at the fetlocks and crepitus could be distinctly heard about the quarter region. He was supported and moved along quietly for about

200 yards. The near hind limb was adducted and moved as if there was pelvic injury. This, together with the marked crepitus, which could not be definitely localized, made it impossible to give an opinion until pelvic examination could be made.

It was late in the evening before a float could be obtained. The animal lay down and remained down at the spot to which



Fracture of Vertebræ.

it was moved soon after the accident, and I was informed that when getting him into the float there appeared to be total paraplegia.

On its arrival at the sick lines I again examined the case and found complete paralysis accompanied by anæsthesia of the hind quarters. Examination *per rectum* showed the pelvis to be

intact, fracture of the spine was diagnosed, and destruction carried out.

*Post-mortem Appearances.*—The superior spinous processes of the 5th and 6th lumbar vertebræ were broken off close to the neural arch, portions of the lateral walls of the neural arch of the 5th vertebra were broken off, the neural arch of the 6th vertebra was completely destroyed.

The extremities of the transverse processes of both bones were fractured on the left side.

I am indebted to Major A. C. Newsom, A.V.C., Army Veterinary School, Aldershot, for the photograph.

## EVERSION OF THE BLADDER IN A MARE.

By FREDERICK HOBDAY, F.R.C.V.S.
*Kensington, W.*

On Sunday, June 25, I was called in consultation by Mr. Frank Thompson, M.R.C.V.S., of Plumstead, to a case of complete eversion of the bladder in a Shire mare. The animal was only 6 years old, the property of a contractor, and had foaled quite unexpectedly on the 23rd about 4 a.m. The foal was born alive and the parturition apparently normal. Nothing unusual was observed until about 8 p.m., when the mare commenced to strain and a reddish-coloured body protruded from the vagina. The owner, thinking that the cleansing had not all come away, called in the advice of Mr. Thompson, who diagnosed eversion of the bladder. The rectum was impacted, but this was speedily relieved with enemas of warm water and an attempt was made to return the everted bladder. Morphia was administered and hot water freely applied, but upon manual manipulation the mare strained so violently that all efforts to return it were unavailing. When first examined it was twisted upon itself and turned back in the vagina, and it was only after several attempts that this difficulty was got over. On the 24th, Mr. Thompson again tried but without success, and on the 25th, when we saw it together (fully forty-eight hours after eversion) it presented a thickened and enflamed appearance of the mucous membrane. The ureters were visible and the urine collected in a pouch of the vagina, being ejected at intervals in a squirting stream when the bladder was touched and the mare strained. Hot chinosol solution was applied, together with gentle massage, and after about an hour the walls became limp enough to attempt reduction. This was done very carefully with the aid at first of the fingers and the

wooden end of an ordinary horse enema syringe. When the length of this was found to be insufficient to return the fundus of the bladder through the urethral orifice Mr. Thompson very ingeniously devised a pessary composed of a small rounded glass pestle firmly tied into the end of a piece of garden hose pipe. This, after being sterilized and well vaselined, was inserted into the fundus in the place of the nozzle of the enema syringe and presently the whole mass returned through the urethra. The bladder was thoroughly douched with cold chinosol lotion and the mare left to her own devices, a warm feed of mash being given to her to occupy her attention.

Recovery has been quite uneventful and there has been no straining or return of the prolapse.

## SPASM OF THE DIAPHRAGM IN A COW.

By H. K. KREDO.

On February 18 I was called to a six-year-old Dutch cow, which, according to the owner, had become suddenly ill after feeding and probably had a foreign body in the œsophagus. Patient showed neither salivation nor tympanitis. The breathing was accelerated, 60 per minute, laboured, chiefly abdominal spasmodic and grunting; the mouth held open and tongue hanging out. Inspiration appeared jerky. The respiratory movements corresponded with those of the heart; the lungs were clear; the digestive apparatus healthy. To satisfy the owner the probang was passed and was introduced easily and smoothly.

Kredo diagnosed spasm of the diaphragm in consequence of affection of the sensible branches of the phrenic nerve, probably due to a foreign body. The strong stimulation of the nerve was reflected on the heart-beats due to its situation at the base of the heart, the spasms corresponding with the systole of the auricle. Kredo prescribed magnesium sulphate in the hope that the foreign body would be re-drawn into the reticulum. After two hours the cow settled down and seemed easy. On the following evening after eating, the same symptoms recurred and continued for three hours. Further attacks did not occur.

On April 23 the author was again called to the cow. An abscess had formed at the back of the xiphoid cartilage. On opening up, a large amount of pus was evacuated and a piece of wire brought to light. Kredo considers in consequence that his first diagnosis was correct.

## CEREBRO-SPINAL MENINGITIS.

By HENRY B. EVE, M.R.C.V.S.
*Folkestone.*

*Subject.*—An aged (about 12-15) roan gelding, 16 hands, a vanner used for carting mineral waters.

*History.*—The horse had been in regular work daily, in fact, overworked owing to the season here being at its height. The owners had had it over ten years, but it had never had a day's illness up to now, bar lameness due to a sandcrack, which I treated five years ago with a satisfactory result. It was watered and fed overnight, also in the morning early by the carman, and seemed all right as usual, and was duly harnessed to the van along with another, when suddenly it became frenzied and uncontrollable and had to be quickly taken out back to the stable, which was done with difficulty, and I was 'phoned for at 8.45 a.m.

*Symptoms*, 9 a.m.—Dizziness and vertigo quickly followed by total loss of motor power, which was so complete and sudden that the horse fell prostrate to the ground ere it had been in the stall five minutes before I arrived. The animal had a wild look about its eyes and the injected conjunctiva indicated that the "cerebrum" was affected, although consciousness was only somewhat impaired. The pulse and respirations were accelerated, hyperæsthesia especially at the anterior part of the animal, and chronic contraction of the superior cervical and dorsal muscles were noticeable. The bowels were constipated and urine suppressed. The temperature was elevated, but variable, and intermittent.

1 a.m.—Visited animal and found pulse slow, coma, stertorous breathing and total paralysis present. Temperature subnormal.

*Diagnosis.*—Cerebro-spinal meningitis (mad staggers).

*Prognosis.*—Guarded, unfavourable, feared syncope.

*Treatment.*—Hypo. Inj. physostigmine and pilocarpine given to relieve constipation; passed catheter, and gave sedative draughts chloral hydras, pot. bromid and glycerine ext. belladonna. Locally applied ice-bags to the spine and head. Unable to sling owing to the premises being unsuitable.

*Diet.*—Laxative, oatmeal and linseed gruel.

*Result.*—The next day advised the firm to have it shot as the case appeared hopeless, which was done, and unfortunately I was unable to make a *post mortem*.

# Abstracts and Reports.

## BRIEF REPORT ON THE VETERINARY INSTITUTIONS OF JAPAN.*

By R. F. KNIGHT,
*Assistant Chief Veterinarian,*
AND
C. G. THOMSON,
*Superintendent of the Serum Laboratory.*

Indexed B. A. I.

### Organization.

The veterinary work forms one of the divisions of the bureau of agriculture, which is under the administration of the Minister of Agriculture and Commerce, and to it are assigned the inspection of meat, the inspection and quarantine of imported animals, and the control of contagious and infectious animal diseases. Although the improvement of equines is left entirely in the hands of the military department, the remainder of the animal husbandry work comes within the field of the bureau of agriculture, and so much has been done along this line by the importation of foreign stock that in some localities it is difficult to find an animal of pure Japanese blood. Numerous publications pertaining to the veterinary work and organization have been issued in the form of pamphlets and compilations.

### Rinderpest Eradication.

The work of the eradication of rinderpest in Japan by the bureau of agriculture is greatly facilitated by existing provisions, not only for the slaughter of animals affected with this disease, but also for those suspected of being infected. Quarantines are maintained against the districts where disease prevails by an efficient police force in such a manner that there is little danger of the extension of the area infected. As a matter of fact, however, the Japanese people have such a hearty respect for law and order that there are few attempts to violate any quarantine regulations that are imposed.

In addition to the slaughter of the animals affected and those directly exposed, and strict quarantine over the infected locality, the injection of anti-rinderpest serum is practised upon the neighbouring animals which are not known to have been directly exposed to the disease. The Japanese officials believe that anti-rinderpest serum is valuable in stamping out an epizootic of rinderpest, and that in the majority of cases a dose of 100 c.c. can be depended upon to confer a passive immunity to the average animal for a period of two or three weeks. It appears that their conclusions regarding the value of anti-rinderpest serum have been drawn principally from literature. They use serum largely on those individuals which they believe are not exposed and where they do not expect the

* *Tropical Agriculturist*, ex *Philippine Agricultural Review.*

disease to appear. The fact that they do not have a large number of cases among animals that have been injected with anti-rinderpest serum seems to be due to the fact that very few of the injected animals are actually exposed. Their tests regarding the efficiency of this serum have been, so far as could be ascertained, the simultaneous injection of large doses of serum and virulent blood. It is believed that the simultaneous injection of large doses of serum will greatly reduce the percentage of mortality in animals that are given virulent blood, but this does not prove that the injection of anti-rinderpest serum will prevent an attack when an animal is exposed several days after the injection of serum. However, some of the Japanese, especially Dr. H. Tokishig, Superintendent of the Institute for the Infectious Diseases of Animals, believe the injection of anti-rinderpest serum to be of little value except when used in connection with other measures, such as the slaughter of infected individuals and those directly exposed, strict quarantine of the infected district, &c. During the past few years outbreaks of rinderpest in Japan have been largely due to the importation of disease from China and Korea. On several occasions they have suffered from small outbreaks which have been traced to these sources, but these outbreaks have been speedily suppressed by stringent measures, and the country has remained free from rinderpest until another importation of the infection. Japan suffered its heaviest losses from rinderpest in 1896, for which year about 7,000 deaths are recorded. This infection was stamped out during the same year, and no new cases appeared until 1899. Since then the disease has appeared from time to time through importations received from the mainland, but it has never seriously menaced the livestock industry. At the present time Japan is entirely free from rinderpest, and to prevent the importation of contagious and infectious animal diseases the Government has installed quarantine stations at the principal ports and has issued stringent regulations governing the inspection and quarantine of animals received from foreign countries.

### Quarantine Stations.

One of the quarantine stations, that at Yokohama, was visited. It is small, accommodating only about 50 animals, but as practically no animals except those for breeding purposes are imported at Yokohama, it is of sufficient size for that port. The quarantine station is located about five miles from the central part of the city, and is situated on a small inlet so that live stock can be transported directly from the steamers to the place of quarantine.

The entire station occupies about three-tenths of a hectare of ground, and is surrounded by a tight board fence about three metres in height. In the centre of this area is a building of two stories which is used by the quarantine officials as an office. Around this central structure are several other buildings used for the detention of animals. These buildings are constructed

along sanitary lines, having concrete floors and electric lights. They are well ventilated and offer ample room and comfortable accommodation to the animals. Some of these buildings, those used for the detention of animals which may have been exposed to any of the diseases which are most commonly transmitted by flies, are provided with double screen doors and windows. In addition to these structures, there is a small building located in one corner of the grounds for the isolation of suspected cases of disease, and another similar building which is used exclusively for *post-mortem* work. Bovines and other animals susceptible to rinderpest, imported from foreign countries where rinderpest is known to exist, are held at this quarantine station for twenty days after their arrival. In case rinderpest develops among any of the imported animals during the period of quarantine, the entire herd is slaughtered, and without indemnity to the owner. These regulations do not apply, however, to cattle imported for slaughter, as these are held in quarantine for two weeks only, after which time they are required to be slaughtered within three days.

### Slaughterhouses and Meat Inspection.

The cattle dealers and butchers are required to furnish men for slaughtering their animals, and they are charged a moderate sum for the use of the abattoir (for cattle and horses, 1 yen* per head, and for hogs, 25 sen). The buildings connected with the Government abattoir at Tokyo cover about one-fifth of a hectare of ground which is enclosed by a board fence. On two sides of this enclosure are sheds for tying animals which are awaiting entrance to the slaughterhouse. The hours for slaughtering are from 5 a.m. to 10 a.m. There is daily inspection before killing commences of the clothing worn by the men working at the slaughterhouse and of all baskets and other utensils.

The Government inspection of meat consists of a careful *ante-mortem* inspection of the animals and a thorough *post-mortem* examination of the carcase. The *ante-mortem* inspection is conducted in a shed which is near the entrance of the main building and equipped with scales for weighing the animals. Near this shed is a building used as an office for the veterinarians and police officers in charge, and at one end of this latter structure is a laboratory sufficiently equipped to enable the veterinarians to make a microscopical examination of the abnormal tissues revealed by the *post-mortem* examination. This laboratory is supplied with glass jars and preservatives for the collection of interesting pathological specimens which are occasionally encountered.

The main structure, where the butchering is performed, has a concrete floor with deep grooves running in two directions so that the fluids are carried into the main gutters without

* 1 yen = 4s. 3½d.; 25 sen = 1s. 1d.

spreading over a large area of the floor. The walls, to the height of 1½ metres, are enamelled tile. About one-third of this building is partitioned off for the dressing of cattle. These are skinned on the floor, and then by means of men and tackles, are hoisted to a track where they are eviscerated. A *post-mortem* examination is made in this room, and if no pathological lesions are found, the carcase is stamped and passed for food. If any abnormalities are revealed, the carcase is run into a separate room for a final examination, and the viscera are carried into another room, where they are placed upon a table and given a thorough examination in order to ascertain whether or not the carcase or any of its parts are fit for human consumption. A room adjacent to the main killing floor is devoted entirely to the cleaning of the viscera. Hogs are slaughtered on the opposite side of this building, and go through the same system of inspection as the cattle. Horses and other animals are occasionally slaughtered, but cattle and hogs form the principal means of supply. Condemned carcases are taken from the slaughterhouse to the crematory, while condemned parts, such as lungs, livers, &c., are rendered sterile by boiling at the slaughterhouse and then used for fertilizer.

The Government slaughterhouses are under the supervision of the Police Department, and the stamps with which the quarters are marked bear the words, "Inspected by the chief of the Police Court." The Bureau of Agriculture inspects the meat and decides whether or not it is fit for human consumption. The remainder of the work at the abattoir is under the supervision of the Police department.

The inspection of meat is very thorough, and all meat imported into the Philippine Islands bearing the stamp of the Japanese Government may be considered fit for human food unless affected by decomposition or other changes which have taken place after the inspection. At the Government abattoirs in Japan, a great many parts are condemned on account of the presence of animal parasites. Among those more frequently found are *Echinococcus*, the *Strongylus paradoxus*, and the *Distoma hepaticum*. The first of these often produces in the lungs a marbled appearance, which on microscopical examination somewhat resembles a lung affected by contagious pleuropneumonia. The last of the three mentioned is very common, and when this parasite is found the entire liver is condemned. Aside from the parasitic affections, tuberculosis is one of the diseases most frequently discovered. This disease is quite widespread in Japan, and the Government has taken important steps toward its control.

### Institute for the Infectious Diseases of Animals.

In connection with the control and eradication of animal diseases, the Bureau of Agriculture maintains at Tokyo, under the direction of Dr. H. Tokishig, a laboratory, well equipped for experimental work and the production of serums and vaccines.

The scope of its work is indicated by the following table, showing the quantities of various preparations there during the year 1909:—

| | | |
|---|---|---|
| Anti-rinderpest serum ... ... ... | litres | 400 |
| Anthrax serum ... ... ... | do. | 151 |
| Anthrax vaccine ... ... ... | do. | 5 |
| Tuberculin ... ... ... ... | do. | 33 |
| Mallein ... ... | cubic centimetres | 725 |
| Chicken cholera vaccine ... ... | litres | 40 |
| Swine erysipelas serum ... ... | do. | 2.5 |
| Anti-streptococci serum ... ... ... | do. | 29 |

The preparation of serum for hog cholera and blackleg is being commenced, but up to the present time very little has been produced.

All the animals at the institute are inclosed in the same yard, so that great precautions are necessary to prevent the spread of the different diseases from one stable to another. For this reason animals are kept in fly-proof sheds which are so constructed as to readily permit a thorough disinfection. The unnecessary passage of attendants from one building to another is prohibited, and all persons entering any part of the grounds, except the laboratory proper, are required to wear rubber boots which are immersed in antiseptic baths upon leaving any of the buildings. The institute covers about one hectare of ground, and is enclosed by a high fence. About thirty-five animals are used in the production of anti-rinderpest serum, besides a few others which were being held as virus carriers.

The general method of the production of anti-rinderpest serum is very similar to that which is being practised in the Philippine Islands, but the process of immunization is a trifle slower. The animals are bled twice during a period of three days about two weeks after the inoculation of 700 or 800 c.c. of virulent blood. No rules are laid down as to the number of bleedings which each animal is to undergo, but the treatment of individuals depends greatly upon the need for serum, the amount of virus available and other factors. As a rule animals are discharged after the second bleeding following inoculation of 3,000 c.c. of virulent blood. The men in charge of this work claim that larger doses of virus do not give a corresponding reaction, but tend to be destroyed rather than absorbed. They maintain that the serum animals may be used for the production of serum indefinitely without any reduction in the potency of the serum produced. After being placed in stocks the animals are bled from the jugular vein by means of a trocar and cannula, the blood being received into a cylindrical glass jar about 10 or 12 cm. in height and of a capacity of about 400 c.c. After the blood is drawn these jars are covered by means of glass plates. They claim that a much better separation of bovine serum is obtained by the use of this type of jar than with all cylindrical ones of a smaller diameter. After the separation of the serum from the solid parts of the blood, it is drawn from the jars by means of a pipette, and without

filtration is sealed for delivery in brown glass bottles of 10 c.c. capacity. It is said that abscess formation seldom follows the injection of this unfiltered serum.

They think that the strength of the individual has much to do with the efficiency of the serum produced, and on this account they use only strong robust bulls as serum animals. Those which give a medium reaction to the inoculation of virulent blood are considered better for the production of serum than those which experienced a very strong or very weak reaction, as those giving a very strong reaction are believed to be weak individuals. Before a serum animal is put into constant use as such his serum is tested on a calf and must protect the calf in doses of 110 c.c. per 100 kilos. against the simultaneous inoculation of virulent blood.

### Veterinary Inspection.

Besides maintaining quarantine stations and slaughterhouses and laboratories for the preparation of sera and vaccines, the Japanese Government has gone still further and has established a veterinary course to prepare men for recommending and carrying out the sanitary principles for the preservation of live stock. The course is given in the Imperial University at Tokyo, and for entrance the completion of a course in one of the "higher schools" is required. The period of instruction covers three years of ten months each, and includes the principal subjects pertaining to veterinary and sanitary science.

The main building used by this course is occupied by class rooms, laboratories, and museums. The museums are especially well equipped, containing numerous specimens and models. The anatomical section contains skeletons of all domestic animals, models of the organs of special sense and viscera, and paper models of the head and limbs, showing the relative positions of muscles, nerves, bursæ, ligaments and blood-vessels. These models have been prepared by the professor of anatomy by means of plaster of Paris casts of dissected specimens, and are as natural and accurate as models could be made. In relation to horse-shoeing, there are specimens and drawings illustrating the positions occupied by the bones in various attitudes of the horse. Horse-shoes from various parts of the world are exhibited as well as shoes for correcting all abnormalities. Another section contains animal foodstuffs, both foreign and Japanese, and specimens of nearly all the medicinal plants. Models of horse stables and dairy barns, as well as of models of the different breeds of stock are used for instruction in animal industry. Besides the models and specimens already mentioned, the museum contains a large supply of pathological specimens which have been collected by the faculty.

At the rear of the main structure are three buildings used for hospital purposes. One of these provides stable room for about twenty large animals. Another is used as a small animal house, and contains accommodation for about forty cats or dogs. Both of these buildings contain consultation and operating rooms,

and are fully equipped with instruments and apparatus for clinical work. Horses are shod and clipped at the hospital, the owners being required to pay a small sum for the expense incurred.

As a whole the veterinary course seems to be very thorough and up to date in every way, and compares very favourably with the courses given at the veterinary colleges in the United States.

### Conclusion.

The Japanese have shown a clear understanding of the importance of animal diseases by the establishment of suitable quarantine stations and abattoirs, and of excellent veterinary colleges and laboratories for the study of subjects pertaining to veterinary work and the education of men to protect their live-stock interest. The enactment of wise legislative measures again demonstrates their realization of the importance of live-stock protection as well as a confidence in the men who are making a life study of this work. This realization of the importance of the live-stock industry and the confidence placed in the men capable of its protection, together with the determination of the veterinarians to put into actual practice all sound theories pertaining to the work, have in recent years prevented animal diseases from causing serious losses. There are many points in the laws, methods, and institutions pertaining to veterinary work in Japan that are worthy the consideration of other countries.

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## FEEDING AND IMMUNITY IN HÆMORRHAGIC SEPTICÆMIA AND RINDERPEST.*

Indexed B. A. I.

By Major F. S. H. BALDREY, F.R.C.V.S., D.V.H., I.C.V.D.

The following results of experiments as to feeding and watering with hæmorrhagic septicæmia infected material are of very practical importance.

Gaiger [1] recorded that by feeding buffaloes with infected hæmorrhagic septicæmia material they failed to contract the disease and subsequently had an immunity. Baldrey [2] noted that feeding failed to reproduce the disease in rabbits, providing no injury of the buccal mucous membrane was present. If the stomach was rendered alkaline, infection followed, but if normally acid there was no infection. The following experiments were made to explain the possibility of cattle becoming naturally immunized against hæmorrhagic septicæmia:—

### *Experiment No. 1.*

Bulls Nos. 2506 and 2549 received each in water 1 c.c. of an agar washed emulsion of a forty-eight hours growth of living hæmorrhagic septicæmia. The number of organisms given in each case was 779,000. The emulsion was administered as a drench; forty-eight hours after they received again a like quantity.

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* *Journal of Tropical Veterinary Science.*

As a result of this no clinical symptoms were manifested, neither was there any appreciable rise of temperature.

Eleven days after the last administration these two animals each received 0.1 c.c. of a forty-eight hours broth culture subcutaneously. Temperature was irregular for three days but never higher than 39.4° C. Slight swelling at the seat of inoculation, but no systemic disturbance. Recovery was complete and uneventful.

A control inoculated with exactly the same quantity of the same culture died in thirty-four hours.

*Experiment No. 2.*

Bulls Nos. 3136, 3132, 2541, 3232, 3166 and 2525 each received in food 1,760,000 living organisms of hæmorrhagic septicæmia and forty-eight hours later the same quantity. In order to ensure complete ingestion the animals were kept without food for twelve hours, and the emulsion of bacteria was then mixed with about 1 lb. of damp meal. Every particle was eaten up out of the tin dishes in which it was mixed. No. 3166 died of hæmorrhagic septicæmia on the third day after the second dose of bacteria. The organism was recovered from the heart's blood.

The remainder showed no appreciable symptoms and were tested for immunity thirteen days after the last administration of organisms. The dose given was 0.1 c.c. of a forty-eight hours broth culture subcutaneously. A control was given the same amount.

*Result.*—Control died in twenty-four hours. Bull No. 2525 died in thirty-two hours. Pure culture of hæmorrhagic septicæmia recovered from heart's blood of each. The remainder recovered. Their temperature rose 1—2°, and there was swelling at the seat of inoculation. The former persisted for two to three days and the latter for the same period, but recovery was spontaneous and uneventful.

*Experiment No. 3.*

Bulls Nos. 3241, 1924, 1107, 1915, 2523, and 2507, each received in water 1,760,000 living organisms of hæmorrhagic septicæmia, and forty-eight hours later a second administration of the same quantity. The animals were kept without water for twelve hours. The emulsion mixed in about half a gallon of water in a bucket and they then drank the whole of this quickly. These methods of allowing the animals to feed and drink naturally, were adopted to obviate the possibility of injuring the mucous membrane of the mouth by administering the material from a drenching bottle. No clinical disturbance was manifested from the above treatment.

On the thirteenth day after the last dose of organisms, each animal received 0.1 c.c. of a forty-eight hours' broth culture subcutaneously. A control received the same amount.

*Result.*—Control died in twenty-four hours. No. 2523 died in sixteen hours. Pure culture of hæmorrhagic septicæmia, recovered from heart's blood in each case. The remaining five

animals recovered without any marked symptoms beyond a 2° rise in temperature and a slight swelling at the seat of inoculation.

In all the above experiments animals were kept in an absolute state of isolation so that the possibility of outside contagion or infection was impossible.

*Conclusions.*—Of bovines which ingest virulent hæmorrhagic septicæmia material in relatively small quantities 7.1 per cent. contract the disease; of the remaining 92.9 per cent. there are 84.7 per cent. immune to it. The probable method of contracting the disease by ingestion would appear to be when an injury to the mucous membrane of the mouth has occurred and then infection amounts practically to a subcutaneous inoculation. This result has an important bearing on natural immunity and may account for the numbers of animals which in the plains resist infection.

*Remarks.*—As to the vaccination by the ingestion of virulent material it is interesting to inquire how it is produced.

Baldrey [2] has shown that in the presence of acid the organism was rendered harmless to the rabbit by ingestion, but when the stomach was washed out with an alkaline solution infection and death took place. Hartley working in this laboratory has shown the effects of various solutions of acid, alkali and bile *in vitro* upon the hæmorrhagic septicæmia organism as follows:—

### *The Effect of Acids, Alkalies and Bile Salts on the Growth of Hæmorrhagic Septicæmia Method.*

The bouillon used was standardized to +10 on Eyre's scale. A series of 100 c.c. flasks, each containing 25 c.c. of broth were inoculated, each with five drops from a twenty-four hours' old culture of hæmorrhagic septicæmia. A second series of flasks, each containing 25 c.c. of the fluid, the bactericidal power of which was to be investigated, were also prepared and sterilized, and maintained at 37° C. for forty-eight hours, in just the same way as the broth cultures of the organism. The fluid under investigation (acid, alkali, &c.) was added to one of the flasks containing the bouillon culture of hæmorrhagic septicæmia, and subcultures on broth were made at definite intervals (usually 10-minute intervals up to one hour and a final subculture after four hours). The concentration of the acid, alkali, &c., in the original fluid being known, the final concentration of the acid, alkali, &c., when mixed with the broth culture, was readily calculated.

The tubes (subcultures) were grown for three days at 37° C.

The same results in hydrochloric acid were obtained by a parallel series of experiments to which, in addition to the acid in the concentration stated, pepsin was added.

The bile-salt solutions were made up so as to contain equal parts by weight of the sodium salts of glycocholic and taurocholic acids. The bile-salt solutions had an alkaline reaction.

It is seen from the above that the hæmorrhagic septicæmia organism is killed in ten minutes by a .09 per cent. solution of HCl., in ten minutes by a 1.0 per cent. solution of sodium carbonate, and in four hours by a 2.0 per cent. solution of bile salts.

.15 per cent of lactic acid fails to kill in four hours. It was considered of interest to determine how protective vaccination was accomplished by the ingestion of living organisms and if the virulent material was killed by such ingestion and at what part of the digestive tract. To demonstrate this and control the *in vitro* experiments of Hartley the following observations were made.

Bulls Nos. 3579, 3520, 3843, 3711, and 3627 were fed at 6 a.m. on July 23, 1910, with 2 c.c. of hæmorrhagic septicæmia emulsion washed off an agar forty-eight hour growth in normal saline.

*Experiment I.*—Four hours afterwards bull No. 3627 was killed. Inoculations were made in rabbits from the contents of the rumen, fourth stomach, small intestines and large intestines.

The method employed was to take a large quantity of the contents, mix thoroughly with sterile water, pour off the liquid contents, pass through blotting paper, and then centrifuge. Each

| Substance | Concentration | Result | |
|---|---|---|---|
| | | Growth after | No growth after |
| | % | | |
| Hydrochloric acid ... ... | 0.04 | 4 hours | — |
| | 0.05 | 50 minutes | 4 hours |
| | 0.06 | 50 ,, | 4 ,, |
| | 0.07 | 20 ,, | 30 minutes |
| | 0.08 | 10 ,, | 20 ,, |
| | 0.09 | — | 10 ,, |
| Lactic acid ... ... ... | 0.15 | 4 hours | — |
| Sodium carbonate ... ... | 0.3 | 4 ,, | — |
| | 0.4 | 50 minutes | 4 hours |
| | 0.5 | 30 ,, | 40 minutes |
| | 0.75 | 10 ,, | 20 ,, |
| | 1.0 | 10 ,, | 20 ,, |
| | 2.0 | — | 10 ,, |
| Bile salts ... ... ... | .05, .1, .2 | 4 hours | — |
| | .5, 1.0 | | |
| | .2 | 40 minutes | 4 hours |

rabbit was inoculated with 1 c.c. of the sediment so obtained subcutaneously.

*Experiment II.*—Eight hours after feeding bull No. 3711 was killed and exactly the same procedure adopted.

*Experiment III.*—Twelve hours after feeding bull No. 3843 was killed and the same inoculation carried out.

*Experiment IV.*—Twenty-four hours after feeding bull No. 3520 was killed for the same series of examination and injection.

*Experiment V.*—Forty-eight hours after feeding bull No. 3519 was treated as above.

The results of the *inoculations from the contents of the rumen* of all the above bulls caused death in the inoculated rabbits by hæmorrhagic septicæmia afterwards verified by isolating the organism and re-testing. This proved that the organism re-

animals recovered without any marked symptoms beyond a 2° rise in temperature and a slight swelling at the seat of inoculation.

In all the above experiments animals were kept in an absolute state of isolation so that the possibility of outside contagion or infection was impossible.

*Conclusions.*—Of bovines which ingest virulent hæmorrhagic septicæmia material in relatively small quantities 7.1 per cent. contract the disease; of the remaining 92.9 per cent. there are 84.7 per cent. immune to it. The probable method of contracting the disease by ingestion would appear to be when an injury to the mucous membrane of the mouth has occurred and then infection amounts practically to a subcutaneous inoculation. This result has an important bearing on natural immunity and may account for the numbers of animals which in the plains resist infection.

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| | 1.0 | 10 ,, | 20 ,, |
| | 2.0 | — | 10 ,, |
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*Experiment III.*—Twelve hours after feeding bull No. 3843 was killed and the same inoculation carried out.

*Experiment IV.*—Twenty-four hours after feeding bull No. 3520 was killed for the same series of examination and injection.

*Experiment V.*—Forty-eight hours after feeding bull No. 3519 was treated as above.

The results of the *inoculations from the contents of the rumen* of all the above bulls caused death in the inoculated rabbits by hæmorrhagic septicæmia afterwards verified by isolating the organism and re-testing. This proved that the organism re-

mained in the rumen for at least seventy-two hours and retained its virulence for that time. The contents of the rumen are therefore never of a pronounced alkaline or acid concentration, as the hæmorrhagic septicæmia organism remains alive and virulent, and it is probable that the organisms multiply in this stomach. This is confirmed by the results obtained by Smith [4], who found that the reaction of the rumen was always alkaline.

*Inoculations from the Fourth Stomach Contents.*—The same routine was carried out with the contents of the 4th stomach as was done in the rumen. Rabbits inoculated every four hours from the contents up to the seventy-second hour. The result was that only two rabbits died of hæmorrhagic septicæmia, one at twenty-four hours after feeding, and the other from contents taken forty-eight hours after feeding. None after that time. This experiment demonstrates that organisms of hæmorrhagic septicæmia were present in the true stomach twenty-four hours after ingestion, and that they had not all been killed by contact with the stomach juices, and also shows that the acidity of the stomach cannot often be so high as .09 per cent. of HCl.

*Contents from the small intestines* were taken at intervals of four hours after ingestion and tested upon rabbits. As a result it was seen that no living hæmorrhagic septicæmia organisms could be obtained from the small intestine. This demonstrates the passage of material through the gut is very rapid, otherwise all the hæmorrhagic septicæmia organisms must have died, whereas it was subsequently found that living organisms were recoverable from the large intestine. The deduction is that hæmorrhagic septicæmia organisms remaining for any length of time in the small intestine are killed or they would have been recovered by the above experiment. Smith [5] shows that the acidity of the true stomach with a meal diet is .049 per cent, and Hartley's *in vitro* experiments have shown that .04 per cent. of HCl is incapable of killing hæmorrhagic septicæmia even in the presence of pepsin in four hours. It is unlikely that any organisms remain for this length of time in such an acid medium, but it is possible that there is some destruction of these organisms while in contact with the acid of the stomach. The alkalinity of the intestines is never likely to be of a sufficiently high concentration to kill, as .3 per cent. of alkalinity in Hartley's experiments showed growth after four hours' contact. The acidity of the stomach alone is therefore capable of killing every organism, but this result is attained over a large number of bacilli in the small intestine by the process of digestion. By this means organisms appear to be digested and absorbed as a proteid. The passage of the small intestinal contents and that of the stomach is, however, so rapid that many organisms escape into the large intestine as they have not had a sufficiently long enough time in contact with the digestive juices to be killed or digested. The time occupied by the passage through the small intestine of those organisms that escape alive and virulent into the large intestine is less probably than three hours. It is clearly shown that living organisms were found in the large intestine

in under eight hours from the time of ingestion (*vide* experiments on large intestine).

*Experiment on Large Intestine.*—Contents from the large intestine were taken at four-hour intervals and tested upon rabbits in the same way as above. Hæmorrhagic septicæmia was found in virulent form in eight hours after administration per os, also in twelve hours and seventy-two hours. Out of six rabbits inoculated at varying times, three died of hæmorrhagic septicæmia, afterwards verified by cultivatian and sub-inoculation.

The object of the above experiments, *i.e.*, to find out in what way immunity is produced by feeding on virulent culture is, I think, satisfactorily established. It was thought that the organisms were killed in their passage through the stomach, absorbed as dead organisms and in this way act as an antigene. This view was not entirely correct as has been shown by living organisms being recovered from the large intestine, so that all the bacilli were not killed. Examination of the blood by inoculation and culture have failed to find living organisms therein; it therefore appears that vaccination is produced only by dead organisms. That this absorption of dead organisms takes place from the small intestine and that the juices of the small intestine are capable of at least inhibiting the growth and virulence of hæmorrhagic septicæmia, providing their stay in the gut is sufficiently long. The large intestine is resistant to infection inasmuch as though organisms of hæmorrhagic septicæmia remain alive and virulent therein, they are not capable of causing infection through its walls. It would appear that only dead and digested bacilli are absorbed into the system and by this vaccination is produced.

An interesting point from a physiological point of view is revealed in the rapidity with which such ingested solid material is capable of reaching the large intestine of ruminants. It will be seen that hæmorrhagic septicæmia organisms were recovered from the large gut as early as eight hours after ingestion. This appears quick considering that rumination has to take place before the food is passed on from the rumen. No observation was made between four and eight hours so that it is possible that they could have been recovered even earlier than eight hours. As living organisms were obtained from the large intestine, the necessity of deciding if animals which have ingested virulent material are "carriers" of the infection was evident. To observe this point an animal was given 2 c.c. of a forty-eight hours' broth culture and the fæces examined on alternate days for bacteria. Hæmorrhagic septicæmia organisms virulent to the rabbit were recovered from such fæces, up to the fifteenth day after ingestion. The technique adopted in the recovery of the organism was the same as that for the intestinal contents.

Examination of fæces were made up to the twenty-third day, but no hæmorrhagic septicæmia could be demonstrated after the fifteenth day from the date of ingesting virulent material.

It is clear from this that an animal may remain a carrier of infection by the fæces for fifteen days at least after the inges-

tion of hæmorrhagic septicæmia organisms. This points to the fact that multiplication or growth of hæmorrhagic septicæmia takes place in the large gut of ruminants, otherwise it would not take so long for their elimination. The amount of dissemination of the disease is therefore by this means incalculable and such animals are a dangerous focus of infection of the disease. The necessity of destroying by fire all fæces from animals during an outbreak and for fifteen days after is very forcibly pointed out.

The above may explain the method of dissemination and suggests again the possibility of insects (ticks) being actively concerned in it. The infected fæces contaminate grass upon which the tick rests during moults. The tick is infected by this means and becomes the active agent in dissemination. It may also explain the immunity that is acquired by some bovines. They feed upon grasses infected as above explained and unless there is a wound of the mucous membrane contract an immunity by ingesting this material. In the event of a slight abrasion to the mouth there would be a direct and fatal infection providing immunity had not already been established.

With regard to the practical utility to be gained from feeding with virulent material as a means of obtaining immunity, the above experiments show that it would be anything but a safe method to recommend. The results demonstrate that some losses are inevitable and in this differ from those obtained by Gaiger [1]. Only fourteen animals were used in my experiments and it is possible that with greater numbers greater losses would be shown.

### Experiments in Rinderpest.

The possibility of establishing immunity to rinderpest by the administration of virulent material through the medium of food or water led to the following experiments:—

*Experiment I.*—Bulls Nos. 4208, 4211, 4212, 4210, 4213, and 4209 each received in a small quantity of food 1 c.c. of virulent defibrinated blood, from which the serum as collected by standing; forty-eight hours afterwards they each received 5 c.c. of virulent blood treated in the same way. A slight reaction followed. The temperature rising to 39.2° on the fifth day after the second dose, and gradually becoming normal about the tenth day. None of these animals lost weight or showed any appearance of illness to an ordinary examination, beyond the slight rise in temperature as shown by the thermometer. On the seventeenth day they received 0.5 c.c. of virulent blood subcutaneously. Control the same.

*Result.*—The control showed vesicles on the fifth day; bulls Nos. 4208 and 4212 showed vesicles on the fifth day; bulls Nos. 4211 showed vesicles on the fourth day; bulls Nos. 4210 and 4213 showed vesicles on the sixth day; bull No. 4209 showed vesicles on the seventh day.

*Experiment II.*—Bulls Nos. 4215, 4214, 4218, 4219, 4216, and 4217 each received in drinking-water 1 c.c. of virulent de-

fibrinated blood, and forty-eight hours afterwards 5 c.c. in the same manner. The reaction from this was the same as in the Food Experiment I.

Bull No. 4215 died on the fifteenth day from asthenia. Bull No. 4217 showed vesicles of rinderpest on fifteenth day. Remainder all tested for immunity by the subcutaneous inoculation of 0.5 c.c. of virulent blood and a control the same exactly.

*Result.*—Control showed vesicles on the fifth day. No. 4219 showed vesicles on the fifth day; No. 4214 showed vesicles on the seventh day; No. 4218 showed vesicles on the seventh day; No. 4216 showed vesicles on the 9th day.

*Conclusions.*

The feeding of susceptible bovines upon virulent rinderpest material fails to induce immunity, but the conclusion arrived at by Experiment II is that ingestion of such material in a fluid media tends to lengthen the period of incubation. It will be seen that one animal did not develop vesicles until the ninth day.

Controls are absolutely regular on the fifth day. In the food experiment the longest was the seventh day. Such an immunity is, however, of very little practical importance.

Bull No. 4217 contracted rinderpest on the fifteenth day. As all the series of animals were kept in absolute isolation, infection must have been gained, from either auto-inoculation, or during or soon after the administration of the virulent material in the water.

In continuation of the above experiment it was considered advisable to test the immunizing properties of heated virulent blood, with a view to its vaccinating properties by subcutaneous inoculation. Observation showed that:—

Virulent defibrinated blood heated at 45° C. for thirty minutes did not lose its virulence.

Virulent defibrinated blood heated at 50° C. for thirty minutes loses its virulence.

Virulent defibrinated blood heated at 55° C. for thirty minutes loses its virulence.

Virulent defibrinated blood heated at 60° C. for thirty minutes loses its virulence.

By heating at anything over 55° C. there was so much hæmolysis that the fluid was not considered suitable as a vaccine.

Therefore corpuscles heated to 50° C. for half an hour were used as a vaccine; 1 c.c. of this inoculated subcutaneously failed to produce any immunity when tested fifteen days after inoculation. Semner found that he could produce immunity by this means.

Further experiments are proceeding with larger doses of heated blood and will be reported in due course.

*Virulence of Blood.*

In the course of the above research it was desirable to know which part of the blood was most virulent.

We know that defibrinated and centrifuged blood is extremely

virulent, and the following experiments were made to see if the serum was also: —

*Experiment I.*—Serum was prepared by defibrinating blood and centrifuging it. The serum resulting was coloured red, showing that considerable hæmolysis had taken place.

One c.c. of this was inoculated subcutaneously into bull No. 3744. Result, vesicles on the seventh day.

*Experiment II.*—Serum prepared by allowing blood to clot and standing in the cold room. This was quite clear; observed no trace of hæmolysis. 1 c.c. inoculated subcutaneously into bull No. 3968. Result, nil. The bull was tested for immunity twenty-two days after and showed vesicles on the eighth day, demonstrating that the serum produced no protection.

*Conclusion.*—That the virulence of rinderpest is contained in the red corpuscles and is not free in the plasma providing no hæmolysis has taken place. Theiler [3] states that serum does not contain any virulent material and this result is confirmed. It is also demonstrated that the inoculation of such clear serum is incapable of producing any immunity.

I have to thank Mr. Cross and Dr. Hartley for their valuable assistance in carrying out the above experiments.

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(2) BALDREY. *Journal of Tropical Veterinary Science*, vol. ii., No. 3, 1907, p. 287.
(3) THEILER. "Friedberger and Fröhner, 'Veterinary Pathology,'" vol. ii., p. 624.
(4) SMITH. "Veterinary Physiology," p. 131.
(5) SMITH. "Veterinary Physiology," pp. 133 and 121.

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## THE FEEDING OF EQUINES.

BY J. M. CHRISTY.

*Acting Assistant Principal Veterinary Surgeon, Transvaal.*

IN dealing with this matter it is important to understand what is meant by a well-balanced ration, namely, a diet containing a proper proportion of nitrogenous constituents or albuminoids, called protein, to non-nitrogenous substances, called carbohydrates or fats.

The most important constituents of the food for equines are protein, carbohydrates, and fats, the proportions being about one of protein to from six to seven of carbohydrates and fats.

A ration for equines should contain the constituents required for the building up and sustaining of the body, in addition to supplying the power and energy to enable them to do the work expected from them.

In connection with this subject, Mr. Herbert Ingle, B.Sc., F.I.C., F.C.S., wrote in the *Transvaal Agricultural Journal* (volume vi., page 51): "It may be well to recapitulate the conditions with which the ration of an animal should comply. These are: —

"(1) It should contain protein carbohydrates, and fat in suitable proportion for the requirements of the animals. These requirements differ somewhat according to the age, kind of animals, conditions under which they are kept, and other circumstances.

"(2) It should contain in proper quantity, and especially *in proper proportions,* the various mineral ingredients required for the nutrition and formation of bone, and for the carrying on of the various life processes of the animal."

The above was written in connection with bone disease in animals, but I desire to use it in this article as it indicates in a scientific manner the food we should give to the domesticated animals.

As I desire to make this as far as possible a practical article, I refrain from giving tabulated analyses of the various foodstuffs —which can be got from Mr. Ingle's published articles—and will simply confine myself to the undermentioned three tabulated statements and particulars as to how equines are fed in some large establishments in the Transvaal:—

SCALE OF FEED PER ANIMAL PER DAY.

*Horses.*—Mixed feed, 19 lb.; oats, 3 lb.

*Mules.*—Mixed feed, 17 lb.

This "mixed feed" is made up of 12 lb. forage and 7 lb. mealies for horses, and 10 lb. forage and 7 lb. mealies for mules. When green stuff (such as lucerne or barley) or teff hay is obtainable, an equivalent, according to price, is substituted for 2 or 3 lb. mixed feed.

STATEMENT OF COST PER HEAD OF MULES AND HORSES FOR THE SIX MONTHS ENDED DECEMBER 31, 1910.

| | *Horses.* | *Mules.* |
|---|---|---|
| July ... | £1 15 8.346 | £1 3 8.413 |
| August ... | 1 12 10.525 | 1 1 3.505 |
| September ... | 1 9 11.850 | 1 1 3.344 |
| October ... | 1 11 8.688 | 1 3 4.315 |
| November ... | 1 14 1.365 | 1 5 10.777 |
| December ... | 1 12 1.140 | 1 6 7.196 |
| *Monthly average for the six months* ... | 1 12 8.985 | 1 3 8.260 |
| *Cost per head per day* ... | 0 1 1.096 | 0 0 9.475 |

| 1910. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| August ... ... | 248 | animals | for | 31 | days, | £321 | 8 | 2 |
| September ... ... | 288 | ,, | ,, | 30 | ,, | 323 | 11 | 7 |
| October ... ... | 272 | ,, | ,, | 31 | ,, | 348 | 4 | 0 |
| | | | | | | £993 | 3 | 9 |

*Average cost per animal per day*, 9 3-5d.

Fed during three months (August, September, and October):—
Bran, 600 lb.; chaff (cut straw), 111,347 lb.; green forage (lucerne), 109,335 lb.; cut forage (oat-hay), 12,990; grass hay, 101,972 lb.; mealies (crushed), 220,500 lb.; total, 556,744 lb.

Average weight in food per animal per day:—
10 lb. mealies, 5 lb. chaff, 5 lb. grass-hay, 2½ lb. lucerne and bran; total, 22½ lb.

SCALE OF FEED PER ANIMAL PER DAY.

| | Grain. | Hay. | Bedding. | Salt. | Approximate Cost. | |
|---|---|---|---|---|---|---|
| | lb. | lb. | lb. | oz. | s. | d. |
| (*a*) Artillery and draught ... | 10 | 11 | 8 | 1 | 1 | 3 |
| (*b*) Cavalry ... ... ... | 9 | 10 | 8 | 1 | 1 | 2 |
| (*c*) Mounted infantry ... ... | 8 | 9 | 8 | 1 | 1 | 0½ |
| (*d*) Remounts ... ... ... | 5 | 7 | 8 | 1 | 0 | 7½ |
| (*e*) Working mules ... ... | 7 | 7 | 6 | ½ | 0 | 10½ |
| (*f*) Grazing mules when grazing is "good" ... ... ... | 2 | 0 | 6 | ½ | 0 | 2½ |
| (*g*) Grazing mules when grazing is "indifferent" ... ... | 2 | 4 | 6 | ½ | 0 | 5 |
| (*h*) Grazing mules when grazing is "bad" ... ... ... | 4 | 8 | 6 | ½ | 0 | 8¾ |

The scale of rations given above is the standard one. Officers commanding units may draw green forage, linseed, bran, &c., to vary the animal's diet at their discretion, in lieu of any part of the ration, provided that the total cost of the ration is not increased. The majority of units give their horses a warm bran mash once a week. The grain portion of the ration is governed by the price. At stations where oats can be purchased cheaper than mealies they form the standard ration.

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## Translations.

### TRANSMISSION OF INFECTIOUS DISEASES TO ANIMALS IN THE EXERCISE OF VETERINARY MEDICINE.

BY MAJOR M. P. REMLINGER.

LIKE the doctor, the veterinary surgeon exercises his art at his particular domicile or in that of his client. The doctor appears to transmit infectious complaints primarily by his hands, which he is content almost always to wash rapidly in soap and water—quite an insufficient measure—then by his clothes, and beard, on which in speaking, coughing and sneezing (scarlatina, diphtheria, measles, mumps, etc.), the patient projects droplets of virulent material. This method of contagion presents itself equally in veterinary medicine. More even than the doctor, the veterinary surgeon is exposed to the taking up of pathogenic microbes in his hands or

clothes ; he often carries, like his confrère of the superior animals, a beard exposed to the same soiling ; he washes his hands no better than him, nor changes his clothes after each visit to a suspect. Amongst illnesses capable of being transmitted from sick animals to healthy ones, may be mentioned aphthous fever, peripneumonia, rinder-pest, swine fever, erysipelas, glanders, horse-pox, etc. His actions bring many dangers in their train when disinfection of the hands is not assured, *e.g.*, examination of buccal, ocular, pituitary mucosa ; investigation of dentition or dentistry, the appreciation of the dryness of the muzzle. In veterinary medicine, however, the danger of clothes, hands and beard appears greatly excelled by that of the boots, and how should it be otherwise ? Theoretically all affections in which the microbe can be found in fecal matter and the urine may exist some hours outside the organism, and in the end contaminate the animal by the respiratory or digestive tract, and can thus be transmitted by the contagious products which the veterinary surgeon carries from stable to stable adherent to his boots. In the West, above all, aphthous fever ; in the East, rinder-pest is propagated in this fashion. In Turkey the visit to a healthy stable of a real or soi-disant sanitary inspector is often the point of departure of a veritable disease disaster. In many of our countries owners have grasped the relation of cause and effect between the passage of a veterinary surgeon and the appearance of foot-and-mouth disease ; when the epizootic rages they avoid calling in the practitioner as much as possible. The danger of the boots is by no means limited to these two diseases. Erysipelas, swine fever, symptomatic anthrax, diarrhœa of calves, glanders can be equally transmitted in this way.

We shall be brief on the transmission of infectious illnesses by means of certain surgical instruments or medical apparatus. This mode of contamination is too well known to be insisted on, and it is disappearing. Everybody knows to-day that the flame or immersion in an antiseptic is necessary for disinfection of instruments, and that a temperature of 120°, or in case of impossibility, prolonged boiling is absolutely necessary.

It will suffice to name the principal diseases communicated by instruments (tetanus, septicæmia, glanders, pasteurelloses), the operations which have most often given place to accidents (castration, amputation of the tail, subcutaneous inoculations, application of setons) the instruments most incriminated (clams, castration forceps, trocars, seton needles, catheters, shears, twitches, hobbles, thermometers, &c.).

What are the precautions the veterinary surgeon should take ? It appears to me to be unreasonable to ask a veterinary surgeon to sacrifice his beard ; he should wash it with care after he has been in contact with an animal affected with a transmissible malady. It is easy to keep his nails cut and clean, to carry cresylic soap and a bottle of this antiseptic or of one of its derivatives, and to proceed to a thorough disinfection of the hands after examining every contagious malady. A special smock is recommended also in these cases, which can be cleaned and disinfected.

It is most necessary, however, to avoid spreading contagion by the boots and trouser bottoms. They may be disinfected, including

the soles, by means of a large tampon of wool on a wooden or iron rod soaked in a solution of cresyl. A pair of rubber boots which can be put on, taken off, and disinfected at will, serve the same purpose. Such a costume will enable him to be easily recognized, be an advantage to his clients, and increase his prestige. It will, by its example, give him greater authority to have prophylactic measures taken in contaminated places, particularly to forbid access to farms, stalls, stables or piggeries, of butchers, horse-dealers and merchants of all kinds in agricultural trade who are so often, as everybody knows, vehicles of illnesses.

(*Revue Générale de Médecine Vétérinaire.*)

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## ALOPECIA AREATA.

By Staff Veterinary Surgeon POHL.

A horse of the third squadron was given three prophylactic washings with 1 per cent. sublimate water with the addition of hydrochloric acid. This was done on account of the occurrence of lice in the stable. Five days after the last washing there was wide-spread falling out of the hair over the whole surface of the body including the head. The brown hair had lost its customary lustre and appeared covered with an asbestos-like powder (scales) and the hair and its bulbs could be easily pulled out with the fingers. Within two days there arose, especially on the rump and muscles of the limbs, hairless, irregularly-placed, isolated spots of a circular shape and as big as a plate. Itching was not present and scabs did not form. Treatment consisted in removing the falling hair by swabbing the skin with cloths soaked in creolin water. The bald places were sopped daily with 1 in 100 salicyl spirit. After eight days fresh hair appeared, and within three weeks the loss was remedied; the hair was growing everywhere during this time. The extraordinarily quick, almost sudden spread of the falling out of the hair over the whole body which produced in quite a short time very large bald spots on the skin, the quick growth of new hair and the isolated nature of the case excludes *herpes tonsurans*. It seems certain that there was general circulatory disturbance in the skin and on that account faulty root nourishment of the hair, which caused it to fall out. This case and its treatment seem worth recording.

(*Zeitschrift für Veterinärkunde.*)

[*Translator's Note.*—Cases of this description may be described as rare. They are so seldom met with that one is apt to forget that they may occur. The translator has seen one such case as that described herein which followed an attack of influenza and sore throat and was accompanied by laminitis. Talking to a veterinary surgeon of forty years' experience about the matter, he recalls *one* such similar case in his long career. They are apt to puzzle one when they do occur, but the smooth, hairless, non-scabby and non-irritable nature of the complaint excludes a notifiable skin disease.]

## POISONING WITH RED LEAD.

Indexed B. A. I.

By Staff Veterinary Surgeon KLINGBERG.

The owner of a dairy in the neighbourhood of K. had built a new cow-house. The iron beams and pillars had been painted with red lead in order to preserve them from rust—four pillars stood near the crib. Of eight animals standing near these pillars six fell ill, namely, two cows, two stirks and two yearlings. The owner had put the animals in their stalls immediately after painting the beams, so that they licked the wet paint. Two days later the first appearance of illness occurred. The cows were very ill at the beginning, the other four animals showed slighter symptoms of poisoning. A cow died after three days' illness. A veterinary surgeon had not been immediately called in by the owner. The latter had given all the patients medicine under the idea that they were suffering from constipation. I was called in twenty-four hours after the death of the first animal. After surveying the shippon and examining the animals I told the owner that these were not cases of stoppage, but of severe poisoning through licking the red paint. In the remaining sick cow I found the following state: The rectal temperature was comparatively low, 37.2° C.; the pulse rate 40 to 44, pulse irregular and weak; breathing quickened and laboured; eyes were staring, pupils widely dilated; taking of food *nil*; rumen movements scarcely hearable. In spite of appropriate means obstinate constipation persisted for three days. Periodical twitchings of muscle appeared at shoulder, neck and head. The cow then made continued champing movements accompanied by copious flow of saliva. She pressed forward and tried to climb the crib.

The remaining four patients showed slight signs of poisoning. There was more or less diarrhœa due to the owner's medicine. Dilated pupils, subnormal temperature, pulse rate 48 to 72. Both yearlings had sideways champing attacks.

*Treatment.*—Dilute sulphuric acid in linseed mucilage and in the drinking water; milk with white of egg. The cow and a yearling received chloral hydrate in the water and in linseed mucilage. Both yearlings and the stirks were all right after six to fourteen days. The cow died after eight days' continuance of illness.

On *post mortem* there was the following: Cadaver greatly blown up; subcutaneous veins filled with blackish red blood. On the peritoneum and intestinal walls patchy and spotty hæmorrhages. The intestinal canal was almost empty, the mucosa covered with greyish red slime in great quantity. The third stomach filled with firm masses of food. Liver not enlarged. The lungs in the inspiration stage and very rich in blood. In the bronchi and air cavities a fine, bubbly, tenacious, yellowish red foam. On the pleura epi- and endocardium punctiform hæmorrhages. The right chamber of the heart was filled with thick black tarry blood.

(*Zeitschrift für Veterinärkunde.*)

[The *post-mortem* appearances in such cases as these simulate

anthrax somewhat. The translator remembers a great difference of opinion where some cows and calves died on the marshes in the Eastern Counties. It was a question whether they had eaten raddle used to mark sheep, or whether they had died of anthrax.]

## A CASE OF STRANGLOUS ENCEPHALITIS.

By BOUET.

STRANGLOUS encephalitis of the horse is not extremely rare. It is generally the complication of a form of clinically discrete strangles; it can even constitute the only objective manifestation of it as in the following observation.

*Santol*, an Anglo-Arabian horse, fell like a log on his left side on two different occasions. He had fever, inappetence and coma. The fourth day excitation crises preceded death. The autopsy revealed an abscess in the white substance of the left hemisphere. Examination of sections of the diseased tissue showed congestion and inflammation; the localization of microbian agents could also be established. In sections obtained by inclusion these agents have been easily coloured by Gram's method. The streptococci were clearly localized in the lymphatic perivascular sheaths, which enclosed veritable cultures. They appeared under the form of short chains; some had a diplococcic aspect. They were disposed for the most part between the white globules, but were also to be found in the interior of the leucocytes whose protoplasma is then hypertrophied.

(*Revue Vétérinaire Militaire.*)

### Letters and Communications, &c.

Mr. E. Wallis Hoare; Dr. D. A. Hughes; Mr. E. Moss; Capt. Williams; Mr. A. W. Noël Pillers; Mr. L. W. Wynn Lloyd; Dr. O. Charnock Bradley; Professor J. F. Craig; Professor J. J. O'Connor; Mr. W. M. Scott; Mr. H. B. Eve; Mr. F. Bullock; Mr. S. Skelhorn; Mr. L. M. Douglas.

### Books and Periodicals, &c., Received.

Journal of Meat and Milk Hygiene; Proceedings of the Royal Society of Medicine; Journal of the Royal Army Medical Corps; Bulletin of the Bureau of Sleeping Sickness; Bulletins of the Bureau of Animal Industry; Tropical Agriculturist; Agricultural Journal for the Union of South Africa; Rhodesian Agricultural Journal.

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